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ABSTRACT

Research during the first two years of this project indicated that television alone can be an effective medium for teaching complex conceptual behaviors, some more than others. The major task during the third year was to develop and test the efficacy of parental intervention procedures to augment televised skill instruction. Subjects were three- to five-year-old Native American children attending Head Start Centers on the Papago Reservation in Arizona. A parental support system was implemented for the four skill areas: seriation, enumeration, conservation, and question-asking. The four experimental groups included (1) television only, (2) televised instruction with ancillary support, (3) televised instruction with parental support, and (4) television with both types of ancillary support. In the question-asking, seriation, and enumeration studies, performance of the televised instruction group was significantly superior to control groups. Only in enumeration was a condition involving ancillary instruction more effective than television alone. In general, the results of the experiments during this grant have demonstrated that televised instruction based on social learning theory and task analysis can be effective in teaching abstract rule-governed behaviors to preschool children and that, under certain conditions, simple ancillary support may enhance the effects of televised instruction alone. (VT)

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THE EFFECTS OF TELEVISED SKILL INSTRUCTION, INSTRUCTIONAL SYSTEM SUPPORT, AND PARENTAL INTERVENTION ON THE DEVELOPMENT OF COGNITIVE SKILLS: FINAL REPORT ON GRANT NO. OCD-CB-479 FROM THE OFFICE OF CHILD DEVELOPMENT FOR THE PERIOD 7/1/73 - 2/28/77

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&
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Third Year Report on
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THE EFFECTS OF TELEVISED SKILL INSTRUCTION, INSTRUCTIONAL SYSTEM SUPPORT, AND PARENTAL INTERVENTION ON THE DEVELOPMENT OF COGNITIVE SKILLS

There are few children in America who do not spend at least a part of each day viewing television. Survey results demonstrate that over 96% of the homes in the United States have at least one television set (Lyle, 1972). Estimates of the time children actually spend watching television vary, but there is a consensus of opinion that it is not unusual for children to spend as much time in front of their television set as they spend in school, and perhaps more time than they spend in anything more than the most causal interactions with their parents.

It is not simply the case that television is pervasive is its presence in the lives of children; its presence clearly has an influence on their development and goes well beyond providing entertainment (Leifer, _et al_, 1974). During a relatively brief period of our history this technological intrusion into the daily lives of families has taken a place alongside parents, teachers, and peers as a significant agent of socialization for children and youth. Progress reports for the first and second years of the present project have summarized research evidence on the effects of TV on both social and cognitive development, and general reviews of the influence of TV on children's lives (Leifer, Gordon & Graves, 1974; Freidrich & Stein, 1975; Liebert, Neale & Davidson, 1973; Comstock, 1976; Cameron, Kieran & Marchant, 1976) and recommended priorities for research (The Ford, John & Mary Markel, and National Science Foundations, 1976; Comstock, 1976; Comstock & Lindsay,

1975) are available in a number of sources.

Educators and policy makers have been relatively slow in recognizing the full implications of television's influence on children. Most attention has been focused upon demonstrated and presumed negative effects of television. It was not until Joan Cooney, a TV producer, and Lloyd Morrisett, a psychologist turned foundation executive, joined forces in 1966, that serious and systematic attention was given to the examination of television's potential to serve as a positive force for children's learning (Lesser, 1974). By 1968, Cooney and Morrisett's efforts led to support from foundations and governmental agencies for the development of the production effort that became Sesame Street.

Sesame Street was first broadcast in November, 1969, and as Gerald Lesser (1974) so adaptly put it, "The program began an exhilerating ride on a wave of favorable public reaction. The program received great attention in the press and among parents, and was almost universally applauded for its originality and imagination" (p. 221).

Like all efforts with public visability, Sesame Street soon attracted a retinue of distractors who were philosophically opposed to its goals or its methods, or both. Nevertheless, for those who agreed with its aims, there was evidence by the time the first year of Sesame Street had been evaluated (Ball & Bogatz, 1970, 1972) that the program was successful in teaching certain cognitive skills to young children. The children who watched the most learned the most, and the skills which were given the most attention in the programming were the ones that viewers learned the best (Lesser, 1974).

Soon, however, new questions with clear policy implications began to surface. While Sesame Street clearly demonstrated the capability and potential of television for teaching certain basic cognitive skills, the ETS evaulation of the program's second year showed that some of the more ambitious objectives were not achieved. Those goals that were accomplished generally involved associative learning, including such skills as rote counting and associating a label, such as a letter name, with a visual symbol. More complex skills such as conservation of number and mathematical set concepts were not successfully induced in Sesame Street viewers (Bogatz & Ball, 1971). These findings raised the question of whether or not television was capable of teaching complex cognitive processes to young children. This concern was reflected in the priority statement of the Office of Child Development to which the original proposal for the research reported herein was addressed.

The general purpose of the research activities conducted under this grant was to assess the effects of televised models and direct instruction on the development of cognitive skills among preschool children. At the inception of this project there had been little research designed to determine the effectiveness of televised instruction on the development of conceptual behaviors in young children. The present research, therefore, aimed at determining what kinds of skills the medium of television is capable of teaching and identifying the type of format best suited to teaching conceptual behaviors via television. It also explored the relationship of feedback and guided performance to the effectiveness of televised instruction, and the effects of the combined use of television models and direct instruction.

Social learning theory provided the major guiding framework for this research. Both laboratory research (Bandura, Ross & Ross, 1963;

Kuhn, Madsen & Becker, 1967; Surgeon General's Scientific Advisory Committee on Television and Social Behavior) and studies conducted under naturalistic conditions (Chafee, 1972; Freidrich & Stein, 1973) have demonstrated that the viewing of aggressive behavior increases the likelihood that observers will carry out similar acts when given the opportunity. There was also evidence that television viewing may influence pro-social behaviors and attitudes (Freidrich & Stein, 1973, 1975) and intellectual development (Bogatz & Ball, 1971). Other relevant studies have demonstrated that linguistic responses, including the use of different syntactic forms, can be transmitted and modified through the observation of live models. Verb tense and the use of prepositions (Bandura & Harris, 1966; Liebert, Odom, Hill & Huff, 1969; Odom, Liebert & Hill, 1968), sentence kernel structure (Carroll, Rosenthal & Brysch, 1972; Rosenthal & Whitebook, 1970) and the length and complexity of sentences (Harris & Hassemer, 1972) have all been successfully modified through the use of modeling procedures. Research on observational learning has also shown that children can vicariously learn abstract rules by watching an adult perform conceptual tasks. In these studies, young observers were required to induce a particular property or rule from a highly diverse or complex modeling sequence. Such conceptual response classes as question-asking (Rosenthal & Zimmerman, 1972a; Rosenthal, Zimmerman & Durning, 1970), Piagetian conservation responses (Rosenthal & Zimmerman, 1972b; Zimmerman & Rosenthal, 1972), and even creative responses (Zimmerman & Dialessi, 1973) have been acquired and generalized by children through observational learning. All of these studies involved the use of a linear form of programming which differed considerably from the programming format employed by Sesame Street. However, all of these studies were conducted with live models rather than with televised models, and the present research was designed to determine whether or not similar programming procedures could be effective when the instructional message was presented via televised rather than live performances.

While previous research has demonstrated that rule-governed conceptual behaviors can be induced through modeling procedures, from the beginning we thought it extremely unlikely that television alone would be capable of optimally enhancing the development of complex cognitive skills such as abstract thinking and transfer or generalization. The research was designed to determine during the first year whether or not television alone could successfully teach complex rule-governed behaviors, and during the second and third years we planned to investigate the roles of feedback and guided practice designed to augment televised instruction. Procedures to provide feedback and guided practice were designed to be implemented by parents and paraprofessionals. The second year specifically examined the role of ancillary support provided by adults who came from the same population as the preschool subjects and who had received paraprofessional level training. The third year's work was designed to investigate the relative effectiveness of the types of instruction explored during the first two years, as compared with support activities conducted by parents. The results of the first two years work have been presented in detail elsewhere (Henderson, Zimmerman, Swanson & Bergan, 1974; Henderson & Swanson, 1975; Henderson, Swanson & Zimmerman, 1975a, 1974b; Swanson & Henderson, 1976; Swanson & Henderson, in press). The following section summarizes the results of the first two year's work, while the remainder to this report presents a detailed account of research conducted during the final period of the project.

RESULTS OF THE FIRST YEAR'S RESEARCH: INDUCTION OF CONCEPTUAL BEHAVIORS THROUGH THE USE OF TELEVISION ONLY

A series of four experiments were conducted during the first year of the project. The first experiment examined the effects of television programming on children's acquisition of enumeration concepts. Programming did not produce significant differences between experimental and control groups, but there were flaws in the programming which could have been responsible for this lack of success. These flaws included a level of complexity in the story lines which may have obscured the instructional message. Therefore, while the experiment was not successful, it did not seem that this experiment provided a good test of the capability for the television medium to induce such skills in children. Some programming problems were eliminated during the development of the second experiment (conservation), but on the basis of further experiences the staff still considered the conservation programming to be less than adquate. Results of the conservation experiment showed only marginally significant differences favoring the experimental over the control groups.

By the time the third and fourth experiments were conducted, the staff had become much more sophisticated in the development of scripts and in the use of video techniques to highlight the instructionally salient attributes of the model displays. The results of the seriation experiment clearly indicated that carefully designed instructional strategies can markedly influence the development of a rule-governed cognitive skill when presented via television. Not only were the results of the study unambiguous and highly significant, but the outcome was also of clear practical significance. The absolute magnitude of mean change attributable to the experimental treatment was impressive, but perhaps as important was the fact that gains were made by a very high percentage of children. This is an important outcome because often experimental group effects are produced by changes in the performance of a very small number of children who respond well to the experimental treatment. In this study practically every child made gains which could be reasonably attributed to the television instruction.

These results indicate that carefully sequenced instruction in a rule-governed intellectual skill can be taught effectively by depicting the requisite skill and rule statement through the behavior of televised models, and the effects can be maintained for a period of at least one or two weeks. The fact that these results were obtained with a preschool population of children who are relatively isolated from the direct influence of the mainstream culture gives cause for optimism that similar results could be obtained with other populations of young children.

The results obtained hold implications for the development of materials for direct instruction employing videotape. The outcomes also suggest that programming strategies which may be effective for teaching one kind of cognitive skill might not be well suited to teaching different kinds of skills. While research conducted under more naturalistic viewing conditions is needed before the implications of the results of this study can be fully assessed, they do suggest that past failures to teach complex rule-governed behaviors through instructional television programming may not be due to inherent limitations of the medium.

The basic ingredient of the instruction employed in the seriation study included the application of social learning principles, coupled with carefully sequenced programming of components of the conceptual behavior. The outcomes were accomplished with relatively unsophisticated equipment and video products, yet the children attended to the presentations well and learned effectively. Video productions of commercial quality should be even more effective. Further research should be conducted to determine if viewing comparable instruction sequences of professional quality can be effective under naturalistic viewing conditions in homes and classrooms.

The question-asking study also showed statistically and practically significant influences attributable to televised modeling. Psycholinguists often equate imitative or observational learning with simple mimicry. An alternative position offered by social learning theory posits that children abstract linguistic rules from regularity of utterances of speech models in the environment. This study was based on this latter assumption. The target set of inquiry behaviors selected for study was causal question-asking and the children who participated in the experiment provided an especially stringent test of the effects of televised modeling on the production of rule-governed inquiry responses. Questions dealing with causal relations are relatively mature for children of this age (Torence, 1970) but question-asking in general is not a highly developeded skill in most young Papagos because question-asking is not promoted as a means of obtaining information in traditional Papago culture (Henderson &

Swanson, 1974; Joseph, Spicer & Chesky, 1949). Analysis of the data revealed that televised modeling of causal question-asking had a highly significant outcome favoring the experimental groups (p.< .001). Control children displayed no gains from pretest to posttest and retention testing, while experimental children showed gains of 25.6 and 27.3 points from pretest to posttest and retention testing respectively. Experimental effects were clearly not attributable to the performance of only a few select children, since 83% of the children in the experimental group made gains and 67% of them gained 20 points or more. Individual responses of children were highly varied and clearly did not involve simple mimicry.

The results of this investigation show clearly that interrogative linguistic constructions were induced through televised modeling procedures. These findings lend support to the social learning position that children abstract regularities from the speech of models to which they are exposed and they are able to incorporate these forms appropriately in their own linguistic responses. The potential power of television to influence the linguistic performance of children is demonstrated by the fact that children in this investigation were considerably younger than those who served as subjects in previously reported studies of modeling influences on linguistic responses. These children also live in circumstances of extreme isolation and their English language skills are not well developed. These findings, therefore, hold implications for the development of instructional support systems.

RESULTS OF THE SECOND YEAR'S RESEARCH: TELEVISED SKILL INSTRUCTION AND INSTRUCTIONAL SYSTEM SUPPORT

The general goal of the second year's research was to determine the effectiveness of a) televised instruction and b) ancillary instruction in promoting acquisition of question-asking skills, seriation skills, conservation skills and enumeration skills. Separate experiments were conducted for each of these four sets of skills. In each instance, children were randomly assigned either to experimental conditions involving televised instruction only, or televised instruction plus ancillary support, or to a control condition in which they viewed placebo tapes.

In the question-asking study, Papago children attending Head Start Centers in three locations on the Papago reservation were randomly assigned to TV modeling only, TV modeling plus active participation, and control conditions to determine if opportunity to perform behaviors displayed by television models can enhance the effects of observational learning alone on preschool children's rule-governed production of causal questions. The results showed that while televised modeling alone may have a positive and highly significant influence on the children's production of causal questions, the treatment was significantly more effective when the children had an opportunity to perform and receive reinforcement for the behaviors displayed by televised models. Ancillary support provided this opportunity. These findings have both theoretical and practical implications. Studies in the social learning tradition have generally conveyed the impression that vicarious processes alone are sufficient to induce new rule-governed verbal production in young children.

For the classes of target behaviors under investigation here, there is support for this assumption in the present data on the effects of the TV only treatment, and the results of related investigations (Henderson, Swanson & Zimmerman, 1975). However, in most studies of modeling influences on question-asking (Henderson & Garcia, 1973; Henderson & Swanson, 1974; Zimmerman & Pike, 1972) it is impossible to separate the influences of vicarious process and direct reinforcement to subjects for imitative responding. The results of studies done during the second year of this grant indicate that opportunity for participation and reinforcement for imitative responding on a verbal task such as question-asking may produce substantially stronger results than vicarious influences alone. The specific individual contributions of participation and reinforcement to the subject remain to be examined in future research.

From an applied point of view these results suggest that while TV alone may provide an effective means of introducing a set of information-seeking skills for other capabilities that have traditionally not been cultivated in a particular culture, the effectiveness of the media may be substantially enhanced through simple procedures that indigenous people may be trained to employ. The utility of supplementing televised instruction is suggested not only by statistically significant differences in the effectiveness of the two experimental procedures which were examined during the second year, but perhaps even more convincingly by the fact that 94% of the children in the combined treatment group made impressive gains in fluency of causal question production, compared to 53% making similar gains in the TV only group. With the advent of closed-circuit TV and the availability of video discs at reasonable costs in the near future, it may become practical for groups to identify desired capabilities which are not readily available through current social influences and arrange for these skills to be programmed for presentation via television and ancillary support systems which may be implemented by local people with a minimum of specialized training.

In the second study conducted during year two, the influences of televised modeling and televised modeling plus guided practice and corrective feedback on the induction of complex forms of seriation behavior were examined. Modeled behaviors were based on a linear task analysis of hierarchially arranged task components which operationally define seriation behavior. The TV only and TV plus guided practice and corrective feedback groups made significant gains from pretest to posttest, which were maintained during retention testing. Performance of the experimental groups did not differ from that of controls on the pretest while both exceeded the controls on post and retention trials ($p. < .05$). Performance of the two experimental groups did not differ on post or retention trials.

It is very clear from the results obtained in this study that the vicarious instructional process was a sufficiently powerful one to induce the concept of seriation in preschool children, and that no added advantage was displayed by children who received the additional component of practice and corrective feedback. This result is in marked contrast to a number of other studies on concrete operational behaviors where the corrective feedback dimension did lead to superior performance (Zimmerman & Rosenthal, 1974a; Henderson & Swanson, 1975). Despite the fact that the task was operationalized in a much more complex manner than had been done in previous studies, the results are surprisingly parallel to the simpler but similar approach utilized in the Henderson, Swanson and Zimmerman (1975b) study.

The surprising and unpredicted finding was that the corrective feedback group did not display any added advantage over the TV only subjects despite the fact that the former had the opportunity to practice the skill in an error-free instructional setting and furthermore were reinforced for that correct performance. They still failed to display a greater proficiency in the skill than children who had only observed the skill performed vicariously. This outcome is even more surprising when considered in relationship to the findings of the enumeration and conservation experiments conducted this same year.

The design of the enumeration and conservation experiments was similar to that just described for seriation. For each experiment children were randomly assigned to one of three conditions: Televised modeling of relational terms and relevant mathematical concepts (TI), television instruction plus directed participation, comprised of active responding and corrective feedback (TI+P), and a control group (C). The TI+P condition was most effective for both conservation and enumeration, while children receiving TI only made significant gains but performed at an intermediate level between TI+P and control children. A different pattern was revealed when age was considered in the analysis. In the enumeration experiment, the vicarious processes alone were effective for older children as the combined treatment, while younger children learned the task only in the TI+P condition. Similar results were found in the conservation experiment, with both treatments proving effective for older subjects. However, neither conservation treatment was effective for the younger children.

The results of these two studies are most interesting when examined in relationship to one another and to the outcomes of the seriation experiment.

When the results of the conservation and enumeration treatments were inspected without considering the age factor, the data appeared clearly supportive of the original hypothesis that a directed participation component provides an influential and additive effect to television instruction. In both the enumeration and conservation studies, the combined treatment groups performed at the highest level, the TV only subjects at an intermediate level, and the control group produced the lowest performance.

However, when age is considered, an entirely different picture of the data emerges. For the older children in the enumeration study, the vicarious process alone produced a level of performance almost identical to the performance of the combined treatment group; the children learned just as effectively by observing as by performing and receiving corrective feedback. Such was not the case with the younger children who were able to perform the enumeration tasks only if they had experienced directed participation as well as vicarious instruction. Younger children exposed only to the television instruction did not benefit significantly from the instruction.

The results for the conservation study were very similar to those encountered with enumeration. Here again, the age factor was evident, with both treatments considerably more effectice with the older children. There was no statistical difference between the treatment types for this age group and both far surpassed the control group. It is interesting, however, that in this case it was not possible to detect any statistical difference among any of the groups of younger children. It appears that neither treatment was powerful enough to produce a statistically significant increment in performance of the younger children.

Besides displaying similar patterns of results, there were other commonalities in the task requirements of enumeration and conservation. Both involved a) problems of numerosity, b) both employed relational language terms, c) both utilized a counting strategy for judgment verification, and d) in both conservation and enumeration a correct solution was possible only if visual perceptual cues or dimensions were ignored. Both studies indicated that these skills are much more difficult to facilitate with very young children than with older preschoolers.

The additive effect accrued from directed participation in enumeration and conservation tasks seems to support Piaget's contention regarding the importance of the child's own activity in developing operational concepts (Flavell, 1963), at least with the skills considered here. Especially for very young children, activity appears to be a relevant component of operational training and should be considered in attempts to facilitate cognitive development either with television or more direct instruction.

Another issue suggested by the outcomes of these experiments directs attention specifically to the salient perceptual dimension of tasks involved in inducing concept acquisition through observation. For both enumeration and conservation the specific perceptual cues of stimulus configurations can be confusing and must be overriden to reach a correct judgment.

With enumeration, these perceptual qualities are merely irrelevant dimensions that neither facilitate nor block correct responding. In the case of conservation, however, the perceptual cues are deliberately confounded with numerosity, i.e., length and number dimensions are contradictory. Attention to the perceptual dimension promotes incorrect judgment. Hence, in the case of enumeration, perceptual cues need only be disregarded. With conservation they must be overridden. It is interesting to note, therefore, that the enumeration results for the young children are more positive than the conservation results.

The seriation experiment provides an interesting contrast to the enumeration and conservation results, and raises some issues for televised instruction in conceptual behaviors and for cognitive-developmental theory. By definition, television is a visual medium, and by extension, television instruction is predicated in large measure on visual teaching. Programming for television incorporates other stimuli (e.g. verbal instructions), but the capability of presenting complex visual information is one of television's most salient characteristics. Seriation performance appears to be a very visual skill, at least as it was operationalized in this research. The final solution to the seriation problem provides a very clear perceptual image that can be utilized as a distinct template for a logical solution or performance match. Regardless of the specific characteristics of the stimuli employed, the resulting perceptual configuration is the same, irrespective of the type and number of stimuli employed. This is not true of other concrete operational behaviors such as conservation, in which the perceptual cues are actually misleading and the child must override perceptual information to attain the appropriate logical solution.

This consideration raises two important issues in the acquisition of complex cognitive behavior. The first concerns the role of perceptual clarity in the induction of rule-governed behaviors through vicarious processes. The second challenges the practice of classifying a variety of different skills as manifestations of operativity, when those skills differ on many dimensions including that of visual clarity.

Bandura (1969) has hypothesized that observational learning is effective because, either through imagery or verbalization, an observer can code the information presented vicariously for use at a later time. He further hypothesizes that imaginal coding is a more primitive form of coding than verbal mediation, and hence is more prevalent at early age levels. It is possible that instruction which is based on very clear perceptual cues facilitates imaginal coding and contributes to skill acquisition at early age levels. It also seems probable that skills which are conducive to clear visual instruction will lend themselves better to the television media at least at early age levels than tasks lacking perceptual clarity. An important concern for future research is the specific role of visual cues in promoting concept acquisition, especially as it relates to vicarious learning processes. We cannot assume as some social learning theorists have that the vicarious process of induction will be equally effective with skills that do not possess similar visual properties.

Research conducted during the second year of this grant also calls into question the assumption that diverse skills, such as conservation and seriation, represent a common underlying cognitive process. The present research suggests that specific environmental variables may differentially affect the acquisition of these capabilities. Corrective feedback has been considered an important social environmental variable in studies of the acquisition of conservation (Zimmerman & Rosenthal, 1974a; Henderson & Swanson, 1975). Our second year results indicate that this condition is not critical to the acquisition of seriation. Therefore, it should not be assumed that experiences and processes which influence the acquisition of one rule will influence a different rule in like manner. With a skill in which the perceptual cues are clear and noncontradictory, vicarious modeling of the rules and strategies which constitute the skill may be sufficient to induce the concept. Such was the case with seriation. However, where perceptual cues are irrelevant, as with enumeration, or contradictory, interfering with discriminating the correct solution, as with conservation, active performance and corrective feedback may indeed facilitate acquisition.

It remains to be determined just how visual clarity interacts with the induction approach in facilitating the acquisition of concrete operational behaviors, but it does not seem clear that experiential factors are involved and that we cannot assume that those experiential factors will be the same for all classes of behavior commonly assumed to be expressions of concrete operational thought.

THIRD YEAR RESEARCH

Objectives and Hypotheses

Research conducted during the first two years of this project clearly indicated that television can be an effective medium for teaching complex conceptual behaviors to preschool-aged children. It has also indicated that some kinds of concepts may be taught more effectively than others when television alone is used as the instructional medium. Research to date has also shown interesting patterns of interactions between the nature of the concept to be taught, the age of the target children, and whether instruction was provided through television alone or television supplemented by paraprofessionals who provided guidance and feedback for children who performed the behaviors which they saw modeled on television. While ancillary instructional support which can be carried out by a trained paraprofessional appears to offer one way to provide for active participation, practice, and feedback, parents constitute an alternative resource whose contributions to the effectiveness of televised instruction should be assessed. Parents may potentially play an important role in children's acquisition of skills presented by television because they are familiar with aspects of their children's behavior which are inaccessable to classroom personnel, and which may provide opportunities for application of intellectual skills in the natural environment. Moreover, the literature indicates that the home is a more pervasive and persistent influence on children's intellectual development than is the formal educational environment (Davé, 1963; Wolf, 1974; Henderson & Merritt, 1968; Henderson, 1972). The major task undertaken during the third year of research was to develop and test the efficacy of parental intervention procedures designed to augment televised skill instruction with and without ancillary instructional support.

The specific objectives for the third year of research were as follows:

1. To determine the effectiveness of a) televised instruction, b) ancillary group instruction, and c) parental intervention in promoting acquisition of question-asking skills.
2. To determine the effectiveness of a) televised instruction, b) ancillary group instruction, and c) parental intervention in promoting acquisition of seriation skills.
3. To determine the effectiveness of a) televised instruction, b) ancillary group instruction, and c) parental intervention in promoting acquisition of conservation skills.
4. To determine the effectiveness of a) televised instruction, b) ancillary group instruction, and c) parental intervention in promoting acquisition of enumeration skills.

The specific hypotheses to be tested during the third year of research were as follows:

1. Parent training in instructional procedures will significantly augment the effects of television instruction in promoting child acquisition of question-asking skills.
2. Supplementary group instruction will significantly augment the effects of television instruction in promoting child acquisition of question-asking skills.
3. The combined effects of parental intervention, group instruction, and televised instruction will significantly surpass the effects of any two or fewer of these same variables in promoting child acquisition of question-asking skills.
4. All treatment groups (whether exposed to single or multiple types of training) will evince significantly more proficiency in question-asking than untreated control children.

5. Parent training in instructional procedures will significantly augment the effects of television instruction in promoting child acquisition of seriation skills.
6. Supplementary group instruction will significantly augment the effects of television instruction in promoting child acquisition of seriation skills.
7. The combined effects of parental intervention, group instruction, and televised instruction will significantly surpass the effects of any two or fewer of these same variables in promoting child acquisition of seriation skills.
8. All treatment groups (whether exposed to single or multiple types of training) will evince significantly more proficiency in seriation than untreated control children.
9. Parent training in instructional procedures will significantly augment the effects of television instruction in promoting child acquisition of conservation skills.
10. Supplementary group instruction will significantly augment the effects of television instruction in promoting child acquisition of conservation skills.
11. The combined effects of parental intervention, group instruction and televised instruction will significantly surpass the effects of two or fewer of these same variables in promoting child acquisition of conservation skills.
12. All treatment groups (whether exposed to single or multiple types of training) will evince significantly more proficiency in conservation than untreated control children.

13. Parent training in instructional procedures will significantly augment the effects of television instruction in promoting child acquisition of enumeration skills.
14. Supplementary group instruction will significantly augment the effects of television instruction in promoting child acquisition of enumeration skills.
15. The combined effects of parental intervention, group instruction, and televised instruction will significantly surpass the effects of two or fewer of these same variables in promoting child acquisition of enumeration skills.
16. All treatment groups (whether exposed to single or multiple types of training) will evince significantly more proficiency in enumeration than untreated control children.

Rational for the Specific Experiments

Overall Considerations for Program Design: The studies conducted during the third year focused upon a series of different intellectual skills and concepts, but they shared a number of common theoretical and practical concerns growing out of the patterns of results which emerged from the first two years of research. For instance, it was already clear that all four skills could be influenced by vicarious video instruction, though not all to the same degree. Early results also suggested that some sort of active participation, whether presented as a component of the television presentation or as an ancillary supplement, was of great benefit in facilitating skill acquisition and performance. In fact, results of the first year's work, prior to the inclusion of any activity component at all, suggested that only when a television-supplied activity component was added to the instruction for the second two experiments of year one were dramatic learning changes noted. When ancillary instruction was coupled with television instruction during year two, the results were even more dramatic. It seems clear that all four of the skills that were targeted in programming were learned more effectively when subjects actively performed. By the end of the first two years of this project we had demonstrated that video modeling was effective, and that ancillary activity of some kind certainly augments that effectivenes.

The specific role of subject activity remained undetermined. We still needed to understand what kind of activity was most beneficial, what combination of activities were the most helpful, and what was the upper limit in additive benefit from ancillary components. The series of five studies conducted during the final year were designed to answer the theoretical question of whether or not activity itself is crucial to skill acquisition, and the practical question of whether or not the addition of a parental ancillary instruction component could substantially augment video instruction and paraprofessional teaching.

From a practical point of view, ancillary participation components designed to accompany televised instructional sequences would be expected to be most beneficial when geared to the idiosyncratic learning needs of the individual viewer. Such support delivery could be accomplished in a classroom by a teacher or paraprofessional but might be even more advantageous and certainly more individually directed if delivered by a parent outside the classroom situation. An ancillary instructional supplement provided by parents would be particularly relevant to broadcast television instruction that takes place outside of an academic setting.

This type of ancillary support was the thrust of the third year's investigation.

From the work conducted in years one and two we saw that brief group instructional sequences conducted by paraprofessionals within the limitations of the experimental paradigm did provide additional flexibility and individualization in overcoming some of the limitations of television instruction. These instructional sequences did augment the powerful effects of systematically programmed television instruction. However, an alternative instructional support system could be designed to supply even greater flexibility and individualization in a broader context. A support system utilizing parents as change agents was developed in the final year on this basis. This enabled us to compare the effectiveness of the structured group-instructional model with parental intervention, in order to determine which system combination has greater efficacy as a television supplement, and which is the more practical to provide.

Utilization of parental change agents trained to use principles of modeling and reinforcement has been demonstrated in past research to be a viable and productive method of facilitating concept acquisition. For example, Mexican-American mothers of first grade children were successfully trained to increase the information-seeking skills of their children (Henderson & Garcia, 1973). A similar study was also successful in training Papago Native-American mothers to influence causal question production in their children (Henderson & Swanson, 1974). Parent training based on these principles has also been employed with success to influence academic motivation (Swanson & Henderson, 1976). However, in all these studies the positive results were obtained even when parental intervention constituted the sole means of stimulating intellectual changes. A parental intervention system in combination with a televised instructional component already substantiated as a powerful tool was expected to constitute an effective supplement to televised educational programming.

There are several possible advantages of using a parent-support system based on modeling procedures with a Papago population. First, the ethnological literature suggests that imitation is the preferred and most usual mode of learning and teaching in traditional Papago culture (Joseph, Spicer & Chesky, 1949). In addition, a parental model supplies many model characteristics that are suggested as important in the research literature: (1) same ethnicity (Garcia & Zimmerman, 1972; Bandura, 1969), (2) nurturance (Bandura, 1969), and (3) power over resources (Grusec & Mischel, 1966; Bandura, 1969). A parental model, therefore, could provide a powerful collection of model attributes that would augment other instructional processes.

A second advantage is the extensive familiarity the parent model has with many aspects of the child's behavior. A mother is likely to be more familiar with her own child's repertoire than a paraprofessional. The parent also has the advantage of having observed her child in a wide variety of situations. A mother also has access to the child at many appropriate times and in a variety of contexts and has the opportunity to take advantage of situations for learning in the home. When influence on concept acquisition and application is thus employed across diverse time and contexts, the likelihood is increased that skills and concepts will generalize.

Teaching by parents could provide a third advantage resulting from familiarity with the child's behavior. The parent need only attend to the error patterns of her own child and need only concentrate on corrective feedback to one individual, while the paraprofessional or teacher must attend to and provide feedback for 20 to 30 such patterns.

In summary, a well-developed parental instructional support system could supply an additive learning influence incorporating principles of individualization and flexibility. Such a system could then be systematically compared with the powerful effects of television alone, as well as with television plus paraprofessional support.

Our purpose was to design and implement a parental support system in all four skill areas, to determine if in fact parental teaching could fulfill its promise as a supplement to systematic television instruction.

Related Research - Seriation: The ability to *seriate* was chosen for examination because it is recognized as an important developmental skill. Seriation has attracted a great deal of attention by Piagetian researchers, because it is considered a difficult task for young children to accomplish, and because it had proved amenable to complex television instruction. As Siegel (1972, p. 135) pointed out, "the ability to order objects in a series according to some dimension such as size, is recognized as an important aspect of a child's ability to understand logical concepts." Furthermore, seriation has attracted research interest on the basis of its sequential place in the development of concrete operational thought (Brainerd, 1973d; Murray & Youniss, 1968). It is considered by some to be a behavioral index of ordination processes basic to the development of more advanced numerical concepts (Brainerd, 1973b, 1973e).

Seriation is defined as an additive arrangement of asymmetrical transitive relations, that is, the child can infer that A>C given that A>B and B>C. This is usually examined by directing the child to order an array of objects from the smallest to the largest. However, the ability to order, particularly following numerous trial and error attempts, is not usually considered sufficient. A systematic ordering and comparison strategy is also necessary (Inhelder & Piaget, 1964; Moore & Gallagher, 1973; Elkind, 1964). Such an ordering strategy presupposes the prerequisite skill of size discrimination as well as coordination of the size comparison ordering strategy over a number of stimulus objects. Piaget's findings indicate that while four-year-olds can accomplish simple size discrimination problems, the complete seriation operations are not evidenced until age six or seven (Elkind, 1964). With children younger than four or five, the concept of seriation even with a small number of objects is usually not in evidence (Siegel, 1972).

Other researchers have attempted to examine seriation concepts in less complex ways than through an ordering task (vide Gollin, Moody & Schadler, 1974; Moore & Gallagher, 1973; Siegel, 1972). Even with simpler operationalizations of the skill, emergence of complex seriation performances is consistent with Piagetian predictions. Training procedures have also been effective in teaching simple forms of seriation, (Siegel, 1972; Gollin et al, 1974) but were not extended to the training of a systematic ordering strategy.

The earlier work in the course of the current project is the only body of research to have utilized social learning principles to successfully train children in seriation behaviors which included training the systematic ordering task (Henderson & Swanson, 1975; Henderson, Swanson & Zimmerman, 1975; Swanson & Henderson, 1976a). In this research systematic strategy for imposing order was modeled repetitively across instances of the task via television models, and children actively matched their responses to those they observed, either as an adjunct to the television display (_vide_ Henderson, Zimmerman, Swanson & Bergan, 1974), or as an additional instructional supplement (_vide_ Henderson & Swanson, 1975).

The empirical evidence suggests that seriation is trainable even in young children. However, research has not yet determined which training procedure is the most effective, nor what specific components of a training procedure produce successful results. Since the original training unit, i.e. the television instruction, had proved to be an effective training device, it was retained in full. No changes were made in content of instruction during the final year so that investigation of differences could be directed at the delivery system (parents vs. video) rather than at instructional content.

Since we remained interested in the specific components of the molar instructional unit, a more precise study was also conducted in an attempt to identify in a directed fashion the critical learning facilitators embedded in that display.

Related Research - Enumeration: The second intellectual skill investigated in the present research was _enumeration_, the ability to discriminate the equivalence and nonequivalence of numerical sets. Interest in the development of such premathematical skills has generated empirical research and theoretical discussions (vide Brainerd, 1973; Brainerd, 1973e; Siegel, 1972b). Furthermore, this numerical judgment operation evidences a close relationship to mathematical skills emphasized in the elementary school years, and hence constitutes an educationally relevant set of capabilities. Sesame Street, for instance, has articulated much of its instruction to the objectives of basic counting skills and numerical magnitude judgments, since these skills are regarded by educators and psychologists as fundamental to the mastery of basic arithmetic operations.

During recent years, psychological research has been directed at the sequence of the development of mathematical notions in young children. Much of this work has been concerned with the prerequisite skill components that comprise the ability to discriminate equivalence and nonequivalence. Some of that research indicates that (1) linear magnitude judgments appear earlier than judgments of non-linear magnitude (Siegel 1972b), and (2) that these concepts of equivalence precede the understanding of conservation of number (Siegel, 1971). Other researchers (Brainerd, 1973b, 1973c) propose that set discriminations are the result of ordination processes that developmentally precede cardination processes (i.e. conservation) and which are necessary prerequisites to further arithmetic proficiency. Counting is an ordination operation (Brainerd, 1973c).

Research on counting skills in young children has also been conducted. Potter & Levy (1968) found that accurate counting required that children be able to coordinate pointing and counting with one to one correspondence. Counting accurately and touching pictures only once were significantly related in children up to four years of age. Wang, Resnick & Boozer (1971) found that when counting is used as a strategy for comparing sets which are not arranged in 1:1 correspondence, judgments of more or less are prerequisite to judgments of same and different. However, when sets are arranged in 1:1 correspondence, judgments of same and different are lower on the learning hierarchy than judgments of more or less. In another study (Shannon, 1975) children's error rates in number judgments were significantly decreased following instruction in a systematic linear counting strategy.

From this research base it seems clear that (1) children of preschool age evidence premathematical behaviors, (2) they can discriminate magnitude relationships, (3) linear arrangements are more easily discriminated than non-linear ones, and (4) that counting strategies offer promise as an effective device for making set comparisons.

Research has also been conducted on the developmental sequence of the concepts of "same," "more," & "less," relational concepts essential for judgments of magnitude. Apparently, knowledge of these terms is crucial to the understanding of advanced numerical operations (Harasym, Baersma & McGuire, 1971). In particular, children who are able to conserve evidence a greater understanding of these terms than children who cannot conserve. Donaldson & Balfour (1968) found that three- and four-year-olds did not differentiate "more" and "less" even when they were able to count. In one study (Palermo, 1973), children as old as seven had difficulty differentiating those two terms. Results of another investigation (Palermo, 1974) indicated that children acquire the concept of "more" prior to the concept of "less," and that children who do not understand the concept of "less" treat it as a synonym of "more." In a training study with preschoolers, Uprichard (1969) found the most efficient learning sequence for relational concepts with sets to be "equivalence," "greater than," and "less than."

These research findings were taken into account in constructing the sequential video instruction to be used in project year three. A more complete explanation and description of that content is described elsewhere (Henderson & Swanson, 1975). Since that particular content and sequencing had proved successful in project year two, the video instruction was retained intact. Like seriation, the enumeration study retained the TV programming used during the previous year, the only addition being the inclusion and examination of the effects due to parental ancillary instruction.

Related Research - Conservation: Conservation tasks have attracted voluminous research attention since Piaget noted that such tasks produce remarkably different performances prior to and following the attainment of concrete operational thought. Of the several types of conservation tasks to emerge during the period of concrete operations, conservation of number is the easiest and the earliest to appear (Brainerd & Brainerd, 1972; Reese & Lipsett, 1970).

According to Piagetian theory, prior to the attainment of operational thought the child is able to make quantity judgments on the basis of only one perceptual dimension. Hence, his judgments become inaccurate whenever transformations occur that yield perceptually conflicting information. After the attainment of operational thought, correct judgments are attainable because the child is able to recognize the invariance of quantity despite the presence of confusing perceptual cues. With respect to conservation of number, a child in the concrete operational period can correctly discriminate equivalence of numerostiy despite confounding length and number cues.

Pufall and associates (Pufall & Shaw, 1972; Pufall, Shaw & Syrdal-Lasky, 1973) have done an extensive study of conservation of number with seven object configurations based on four conservation rules that systematically vary spatial properties in relation to number judgments. Unlike most conservation studies, though, transformations were not made in the child's view. In this research the younger children initially vacillated between length and density; the middle-aged children used length exclusively, while only the oldest managed both dimensions to reach correct conclusions.

Rose (1973) did a similar study using the rules and configurations of the Pufall work. Criterion for mastery was based solely on performance, and transformations were not used. Both equality and inequality items were presented to the children. By including both types of items, Rose was able to evaluate the extent to which performance results from acquiescence rather than logical inference. Apparently acquiescence clearly played a large role with three- and four-year-olds while at age five, failures were due to systematic misconceptions about length and number. One point of Rose's study was that the inadequacy of many conservation measures could be overcome by the systematic inclusion of both equality and inequality items. Taking that point into consideration our conservation instruction and assessment was directed at both types of conservation tasks.

The problem of whether non-conserving children can be trained to conserve, and if so, how, has attracted overwhelming attention from developmental psychologists. The results attained and the methods employed evidence great variety, but in sum the outcomes seem to indicate that training may be successful at age levels earlier than proposed for the onset of concrete operations. Early training efforts which were often predicted on Piaget's equilibration model seldom met with much success, but later training studies emanating from other theoretical traditions, such as task analysis models (e.g. Kingsley & Hall, 1967) and perceptual discrimination models (e.g. Rosenthal & Zimmerman, 1972a; Siegler & Liebert, 1972), have reported some success in teaching children to conserve on a variety of stimulus dimensions. All of these studies have treated conservation responses as a form of rule learning and have utilized a variety of methods to constrain the child's attention to the relevant stimulus configuration and influence him/her to disregard the irrelevant stimulus configuration. Much of this literature on the training of conservation in young children has been reviewed elsewhere (Brainerd, 1973c; Henderson, Zimmerman, Swanson & Bergan, 1974; Zimmerman & Rosenthal, 1974b). Those training studies include successful instruction utilizing discrimination procedures (Halford & Fuller, 1970; Roll, 1970) and verbal rule instruction (Figurelli & Keller, 1972).

Experiments in the training of conservation have also been based on a social learning model for instruction. Rosenthal & Zimmerman (1972a) and Zimmerman & Rosenthal (1974a) used modeling procedures in teaching children to conserve across a variety of tasks. They concluded that these procedures were effective with children as young as four years if modeling segments were limited in time and in breadth of target responses depicted. Not only have gains in conservation tasks been produced with modeling procedures, but gains have been shown to transfer across conservation tasks and to be retained over a seven- to ten-day delay (Henderson, Zimmerman, Swanson & Bergan, 1974). Such modeling procedures have also proved successful when adapted for television instruction (Henderson & Swanson, 1975).

It is interesting to note that investigators concerned with training conservation from the social learning paradigm define and teach the task as they would any rule-governed behavior. They accomplish this by varying nonrelevant aspects of the model's performance while holding constant the essential aspects of the task. Moreover, a verbal rule is usually provided, and verbal explanation of the judgmental process is frequently offered. In some cases the verbal rule concerns reversibility phenomena and in some cases the application of counting strategies, but the common element is that the model can and does verbally mediate his performance and his decision-making processes for the observer.

A problem encountered in the assessment of conservation is that the usual criteria for success on the tasks involve not only a correct performance but in addition a correct verbal justification of that performance. Such criteria may place a heavy burden on the young child who has not attained great facility with the use of verbalization in general and the use of relational terms in particular. Siegel & Goldstein (1969) found that young children do not understand the meaning of the word "same" and in fact tend to respond to arrays with regard to the most recent stimulus word presented to them. In another study (LaPointe & O' Donnell, 1974) it was found that children younger than four did not understand the relation of "same" to "more." Griffiths, Shantz & Siegel (1967) also noted the difficulty preschool children experience with the word "same" and found that verbal pretraining was effective in inducing conservation judgments. Others (Harasym, Boersma & Maguire, 1971) have found that conserving children evidence greater understanding of relational terms than do non-conservers.

Research evidence has not yet clarified the precise role that language comprehension plays in the acquisition of conservation, and certainly not whether it is a reflection of logical processes or whether it is a facilitator of them. It is clear, however, that in many conservation studies language and performance are confounded, particularly in the assessment of the child's grasp of the concept. Hence, in our operationalization of the conservation assessment and instruction an effort was made to unconfound these verbal and performance capabilities as much as possible.

Braine (1959) has demonstrated with other concrete operational tasks that Piaget's age levels do not hold when nonverbal means of assessment are employed. He found that children could accomplish performance type tasks at much earlier ages. Brainerd (1973a) pointed out that the use of performance plus judgment criteria is psychometrically unsound and increases the probability of committing a Type II error. Hence, both in the instruction and the assessment of conservation behaviors, the heavy dependence on verbal facility should be eliminated. This was done in the work to be reported here.

Related Research - Question-Asking: The skill of question-asking is regarded in many educational programs as an important "learning to learn" skill. It is widely regarded as a basic intellectual capability which the child can use to obtain information from his environment and assume a role in guiding his own learning (Henderson & Garcia, 1974; Henderson, 1975). The child who can ask a variety of types of questions can obtain information when he wants and needs it rather than depending on a schedule for dispensing information controlled entirely by adults in the environment.

Psychologists and educators who are concerned with the linguistic and intellectual development of children assert that question-asking is of obvious importance in intellectual life (Cazden, 1970) and that question-asking is central to all problem-solving (Blank & Covington, 1965). Suchman (1964), who spent many years developing procedures to teach inquiry processes affirms that:

> ...a realistic approach to conceptual growth must allow the learner to gather and process data in accordance with his cognitive needs of the moment, and this suggests he should be utilizing some kind of inquiry (p. 68).

In pilot testing for an experiment on question-asking, Rosenthal, Zimmerman & Durning (1970) were able to elicit a much lower rate of question-asking from lower SES minority groups than from middle class children. In early studies of the language development of young children, McCarthy (1930) and Davis (1932) found that question-asking behavior develops at a faster rate for higher socio-economic status children than for children from lower socio-economic backgrounds. In a more recent study of culturally different children, Martin (1970) observed that "disadvantaged" black children performed at a "lower level" of question-asking than their more "advantaged" white peers.

There are a number of possible interpretations for these findings. It has been argued that the typical testing or classroom situation in which an adult Anglo-American requires minority students to produce language responses results in the inhibition of the child's verbal behavior (Labov, 1972). Herbert (1970) demonstrated that the children in a tutoring relationship with younger children used more complex language procuctions than they used in the role of student in the classroom. Baratz and Baratz (1970) charged that much of the social science literature on the language of minority groups is flawed by ethnocentric bias. Nevertheless, if Papago children do use fewer and less complex questions than their middle-class Anglo counterparts, then this fact may have implications for understanding the cumulative discrepancy in school performance between culturally diverse groups, and between more and less successful pupils within these groups.

The developmental literature also indicates that while questions of varied types may all play an important role in intellectual functioning and problem-solving, some categories of questions are later than others to emerge in children's linguistic repertories, and probably call for a greater load of information and relationships than simpler question forms. Ausubel & Sullivan (1970) indicate that questions which come early in children's development call for the names of objects and persons, while why and how questions develop somewhat later. Piaget's (1955) developmental study of language of two six-year-old boys revealed a very low incidence of questions calling for explanations in the verbal production of these children. In discussing Isaac's study of questions involved in causal inquiry (Cazden, 1970) argued that "by means of these questions, a disparity between our past experience and some present event becomes for the child (or the scientist) the growing point of his knowledge" (p. 213).

Since causal questions are generally considered to be of critical importance to the intellectual growth of young children, there is a need to identify instructional practices capable of facilitating the learning and performance of this capability.

Considering the fact that question-asking skills have both theoretical and face validity as an important set of capabilities within the larger domain of inquiry skills, surprisingly little experimental research has been done on children's question-asking behavior. Most research on children's question-asking has been descriptive and normative in nature, with data coming from records of children's spontaneous speech, studies of induced questions, and studies of the kinds of questions used by children in the course of problem-solving (Berlyne, 1970).

Gall (1970) reviewed the educational research on question-asking, and concluded that most investigations have centered on teacher behavior and that the shaping of student questioning skills has been a neglected area of research. Examples of the approaches employed in research on teacher's questioning include the use of _The Taxonomy of Educational Objectives: The Cognitive Domain_ (Bloom _et al_, 1956) as the basis for classifying the questions which teachers direct to students (Mason & Clegg, 1970), and the use of question categories derived from Guilford's (1967) Structure of the Intellect Model to study intellectual operations addressed in teacher's questions (Zimmerman & Bergan, 1971). In these and similar investigations there has been no attempt to determine the effect of teacher questioning on the learning or performance of students.

A few investigators have manipulated one or more independent variables, and observed the effects on question-asking and attendant behaviors. Torrence (1970) investigated the effects of opportunity to manipulate objects on question-asking in young children and found that the opportunity to manipulate objects facilitated question-asking in six-year-olds. Working with sixth graders, Blank & Covington (1965) found that an auto-instructional program was effective in facilitating question-asking on criterion tests, promoting participation in class discussions, and that inducing question-asking appeared to facilitate problem-solving on a science achievement test. Berlyne and Frommer (1966) induced question-asking through the use of an orally related story, accompanied by pictures and a "magic trick" involving elements such as novelty, surprise, incongruity, uncertainity, and amount of information. They found that these elements increased the incidence of questions. They also discovered that third grade children asked more questions when they were provided with answers but younger children were not similarly influenced by the provision of answers. The authors speculated that the potential reinforcement value of answers may not yet have been operative in the younger children.

There are four observational learning experiments which provide the more relevant prototype for the strategies employed in the present research. In one experiment Rosenthal, Zimmerman and Durning (1970) demonstrated that modeling procedures were effective in teaching children to discriminate and produce questions falling within several modeled categories, and that the behavior generalized to a new set of stimuli. Zimmerman and Pike (1972) employed modeling and verbal reinforcement procedures successfully to teach question-asking skills to lower SES Mexican-American children in a classroom prototype for small group instruction. The question-asking skill of Mexican American children has also been positively affected through the influence of their mothers who were trained to use modeling, cueing, and reinforcement procedures to teach their children to use causal questions (Henderson & Garcia, 1974). Similar results have been achieved in a field experiment involving the use of native American paraprofessionals to train mothers on the Papago Reservation to teach inquiry skills to their children through the application of basic social learning principles (Henderson & Swanson, 1975).

These four observational learning experiments provided the basis for the instructional strategies employed in the videotapes validated in the first year of the present research (Henderson, Swanson & Zimmerman, 1975) and served as the prototype for the development of the ancillary instruction under consideration here. It should be mentioned that while these investigations document the efficacy of social learning principles for teaching a class of rule-governed behaviors, only the Henderson, Swanson and Zimmerman study (1975) has attempted such instruction with children as young as those who participated in the present research.

School officials on the Papago Reservation report that Papago children ask very few questions, at least in settings where they interact with or are observed by Anglos (Henderson & Swanson, 1975). The ethnographic literature on this group also emphasizes the anthropological observation that traditionally, direct question-asking was not a favored mode for obtaining information. The traditional, culturally preferred way of acquiring skills and information was through close observation and imitation (Joseph, Spicer & Chesky, 1949). While more current ethnographic evidence is not available to indicate the extent to which this pattern may still hold, informal observation suggests that to a large extent this pattern persists today in interpersonal transactions within the Papago culture. However, past research on the Reservation suggests that many Papagos hope for their children to learn the skills which are considered important in the dominant society, while preserving valued aspects of traditional culture. A degree of cultural pluralism is an implicit goal of many Papagos (Swanson & Henderson, 1974). Moreover, many of the parents who have participated in our research training activities are explicit in their belief that in dealing with Anglo-dominated agencies on the Reservation, question-asking is a very important skill.

In view of these considerations, question-asking, more so perhaps than the skills involved in the other experiments, may have a specific value beyond the purpose of testing the efficiency of televised instructional sequences designed to influence the acquisition of rule-governed cognitive skills.

Method

Subjects: The subjects who participated in the four experiments were three- to five-year-old children attending five Head Start Centers on the Papago Reservation in Southern Arizona. Approximately one-fifth of the children attended preschool at the San Xavier site in close proximity to Tucson, Arizona. Another fifth of the children attended the Sells preschool located a distance of 75 miles from the city. The remaining three-fifths were from preschools in Pisinemo, Vaya Chin, and Santa Rosa -- remote Papago villages ranging from 120 to 150 miles from an urban setting. Children at the five sites were randomly assigned to one of four experimental groups or the control group prior to the first study. Following the initial random assignment, the groups remained intact for the full four studies. It was necessary to forego random assignment for each study individually because of the difficulty of contamination from parent involvement, and the logistical problems associated with having to recruit new parent participation four times during the course of the project. Reassignment and re-recruitment would have made it virtually impossible to reach the project's objectives.

The exact number of children available for the research effort fluctuated for each experiment depending upon current enrollment, prolonged absences, attrition, and logistical failures at specific sites. Usually about 15 children were available at the San Xavier site, 20 at the Sells site, and 10 each at the remaining three sites. All children were Papago Indians whose level of family income qualified them for participation in Head Start. While most of the children possessed at least minimal English, some were bilingual, and particularly at the remote sites, some children were exclusively Papago-speaking.

Parents: All parents who participated in the parent training component were Papago native-American mothers residing on the Papago Reservation. Mothers were selected for participation as a result of the random assignment of their children to treatment groups. All were individually contacted and asked to participate, and none refused that involvement. The majority of the participating mothers were bilingual, but a few spoke only Papago.

Paraprofessionals: All paraprofessional employees were bilingual Papago adults. They all lived or had lived in the villages where they were working for the project. They served as the sole contact between the parents and children participating in the project.

Development Procedures: Prior to each study it was necessary to develop the relevant experimental materials, i.e. placebo tapes, evaluation instruments, teaching tapes, and ancillary instructional segments, that would adequately exemplify the skill under consideration within a linear programming format. This procedure involved a multistep process that could be responsive to (1) the findings available from other research efforts, (2) the results of pilot information, and (3) our experience with other skills during the course of the project.

The first step in the process involved defining the skill behaviorally in accord with other research efforts. This definition was stated in the form of a performance objective for the terminal behavior. Second, necessary prerequisite behaviors to the terminal one were specified and cast into a task hierarchy (see Appendix A, Henderson & Swanson, 1975). These task hierarchies were primarily linear analyses that attempted to reflect all necessary intervening steps that would have to be taught to a native subject before the terminal behavior could be reached. Third, a behavioral objective specifying the behavior, condition, and criterion was generated for each step in the task analysis (see Appendix B, Henderson & Swanson, 1975). These task hierarchies became the blueprint for instruction and assessment instrument development. Once the task analysis was specified, it was necessary to pilot the hierarchy with the same-age children. Since Papago subjects of equivalent age were not available, same-age preschool Anglo children were used for preliminary investigation of the procedures. Piloting had several purposes: 1) to check the sequence of skill placement in the hierarchy; 2) to evaluate a number of possible teaching strategies for effectiveness in modeling the skill; and 3) to generate possible verbal rule statements that would be communicable to preschoolers. Following this step the task analysis could be modified as necessary, a specific teaching strategy decided upon, and viable rule statements generated.

All behavioral objectives and task analyses utilized for this third year of study were developed during project years one and two, with only minor revision. The exception to this was the question-asking study in which a much more stringent operationalization of causal question formation was adopted.

Evaluation Instruments: A second task in the development of the procedures for experimentation involved the construction of assessment instruments to be used for the collection of pre- post- and retention data. Evaluation instruments must be carefully constructed if they are to be sensitive to changes in performance that result from experimental treatment. Crude instrumentation may not be sensitive to such change and may mask important results. While this point appears somewhat obvious, it has been noted by some investigators (i.e. Flavell, 1971; Brainerd, 1973a; Brainerd & Hooper, 1975) that measurement questions are not usually addressed in the concept development literature. Some of the psychometric issues to which recent attention has been directed are (1) the use of pass-fail scores in evaluation, (2) the possible methodological difficulties involved with language comprehension when measuring concepts (LaPointe & O'Donnell, 1974), and (3) the use of the performance plus explanation criteria in concept assessment (Brainerd, 1973a). In order to avoid possible methodological problems in the assessment component of the present study, a systematic procedure for instrument development was utilized that was designed to yield reliable tests particularly sensitive to the target behavior selected.

The task analysis developed for each target skill served as a blueprint for each evaluation instrument. The behavioral objectives which comprised the task hierarchy were used for test-item generation. Two items covering each objective were generated and sequenced from the most basic skill through the terminal behavior. This resulted in two parallel item sets that were divided into parallel test forms, both of which were administered during data collection phases. Multi-item parallel forms of this nature, as opposed to a one-shot performance task, offer the psychometric advantage of the use of total score responses for each subject, and make it possible to use accepted numerical procedures to determine instrument reliability. Procedures which make use of all of a subject's responses should be more sensitive to statistical changes, for such procedures are less susceptible to Type II error. Furthermore, tests structured so as to produce numerical measures of reliability better reveal the amount of error introduced into the analyses through the measurement process, than uni-item pass-fail tasks.

Following test development, pilot data were gathered to refine language used in the instrument, to eliminate ambiguities, to decide on maximal test length, and to arrive at a clear testing procedure. It became evident after piloting that tests utilizing a motor performance task rather than a verbal one were more efficient for (1) avoiding an acquiescent response, (2) maintaining the young child's attention, and (3) providing a positive experience both for the children who grasped the concept and those who did not.

Except for the change in the question-asking skill, and some minor modification in seriation and conservation, the evaluation instruments were essentially the same as those utilized in earlier project years (Swanson, 1976; Henderson & Swanson, 1975).

Tape Development: The finalized task analysis also became the skeleton for tape development. Tape segments were prepared to reflect both the specific skills presented in the hierarchy and their sequencing. Each step was modeled two or three times on the tape contiguously before modeling of a subsequent step was initiated. In all segments, the verbal rule for the behavior and the strategies employed were held constant, while the specific model, specific stimuli, and the situations were varied. Each testing segment included 1) the modeled behavior, 2) a statement of the relevant rule, and 3) positive feedback for correct modeled responses. In addition, brief segments were incorporated into tapes in which an invitation to perform was extended to the child-observer. While materials were made available for the child to participate if he wished, no encouragement to do so outside of the video cue was provided. Approximately two participation cues per tape were incorporated.

All instructional segments on the television tapes were unified through the systematic inclusion of a problem-solving strategy for the particular task. These strategies were developed following pilot instruction and selected on the basis of efficiency in instruction with preschool children.

Instructional tapes utilized during this final project year were the same as those developed and validated during the second year of this research effort.

Ancillary Instruction: The task hierarchy also served to guide the design of the ancillary teaching strategies. The instructional objectives and their sequencing were designed to parallel the television programs. However, while the television instruction emphasized modeling of the conceptual behavior, the ancillary teaching emphasized the child's manipulation of the stimulus objects with guided practice to avoid error. In addition, positive reinforcement was provided to the child for each correct response. While the support system was developed to provide the opportunity for active participation, differential feedback, and reinforcement for correct responding, the same modeling paradigm, the same task objectives, and the same sequencing were employed as on the instructional videotapes.

Parental Teaching Component: The ancillary parental training was designed to have exactly the same format as the paraprofessional training component. However, consumable materials that could be inexpensively produced in quantity were utilized so that each participating mother would have her own materials. Those materials were packaged separately into a series of "lessons," each of which was articulated to a specific tape. These lessons were conducted in the home and could not be monitored by the project staff. Since all materials (tapes, ancillary instruction, parent training) were developed on the basis of the same task analysis, they were completely consistent in instructional objective as well as instructional methodology. All were based on social learning principles and utilized modeling and reinforcement procedures.

Training Procedures: The sequence of training all individuals between the development of materials and the delivery of the services to children was extremely complex and time consuming. This two-stage process involvod the training of paraprofessional staff who were then responsible for training the individual parents.

The Papago adults who functioned as experimenters for the studies were required to perform several tasks in the field. First, it was necessary that display competent test administration skills across the four concept areas. Second, they had to be knowledgable regarding experimental control procedures during their interactions with the children and during the presentation of the videotapes. Third, they had to be proficient as teachers within the supplementary instructional system. Since these individuals had little or no experience as teachers or experimenters, they were trained in the specific skills required to carry out their role in the field. A combination of discrimination training and micro-teaching was employed using our videotape capability. Each required performance (e.g. testing, teaching) was broken down into smaller segments and modeled on videotape by graduate assistants proficient in experimental research. The first performance modeled on tape consisted of an overview of the entire performance, accompanied by written performance standards to function as an advance organizer. This was followed by more minute modeling segments which focused on only a small aspect of a desired performance. These model-segments were accompanied by simple performance checklists to direct the trainees' attention to the relevant aspects of the modeled performance. Therefore the trainees were aware of performance standards while viewing the video segments and could utilize appropriate monitoring checklists at each phase of the training.

Modeled video segments were followed by extensive role-play sessions in which dyads of trainee-experimenters practiced the target behaviors until criterion performance was attained. These role-play sessions were supervised by the graduate students who provided feedback to the trainees for the purpose of avoiding errors in performance. Finally, each trainee was videotaped as she performed the entire experimental behavior sequence, and simultaneously her behavior was monitored and assessed by the other trainees. In this way each person was given the opportunity not only to perform, but also to observe and evaluate her own performance. This combination of training techniques proved to be an efficient procedure that resulted in a criterion level performance by all Papago experimenters.

The paraprofessionals also had to learn how to conduct parent training sessions. For this purpose parent-training tapes were made in which the paraprofessional role-played parents interacting with a child in the same format as it was expected the parents themselves would perform when training their children. Each parent training tape was articulated to one and only one "lesson" that the parent would conduct. In addition, the paraprofessionals were supplied with additional instructional materials in the form of printed guidelines to utilize when training their parent groups. Again, role-play techniques were employed in which each paraprofessional practiced conducting training sessions including the use of the video parent-modeling until an acceptable level of performance was attained. Two sets of materials and parent-training tapes were made for each "lesson." One set was conducted in English, the other in Papago in order that they be meaningful to all participating parents.

Actual parent-training was conducted in small groups, on the Reservation during the evening hours when parents were most available. These training sessions were conducted solely by the paraprofessionsls; outside monitoring was not possible. Each training session involved the viewing of a parent-training tape and subsequent role-play by the parents themselves until the teaching procedures were mastered.

While the training components were well-conceived and carefully planned in terms of design, there was no way to provide for quality control of the parent-training sessions themselves, and certainly no way to insure that the parents did in fact proceed with the lesson with their children. Such intrusion no doubt would have been impossible and certainly disruptive.

It is evident that the training steps necessary to carry out project objectives were extremely complex, difficult and time consuming. In general, the following overall procedure was carried out for each experiment:

1) Paraprofessional training in assessment.
2) Paraprofessional training in specific experimental procedure.
3) Paraprofessional training in ancillary instruction.
4) Paraprofessional training in conducting parent-training.
5) Parent-training of participating mothers.

All paraprofessional training was conducted by graduate assistant staff; all parent training was conducted by the paraprofessionals themselves.

Experimental Procedure: A small trailer housing the videotape equipment, teaching activities, and testing materials was located at each site. These trailers provided a controlled setting in which the children could view the teaching tapes, participate in ancillary instruction, and be administered the assessment instruments. Experimenters brought the children to the trailer facility for brief viewing sessions of the video cassettes (10-15 minutes in duration), for brief instructional segments (10-15 minutes in duration), and for testing purposes (15 minutes at each sitting). During the course of any one study a child would participate in an experiment-related activity a maximum of approximately 12 times.

In general, the following course of events followed for each experiment:

1) Each child in each condition was pretested individually on a criterion-referenced evaluation instrument specific to the skill under consideration.
2) First experimental phase: Children in the four experimental conditions viewed the first instructional tape. The four experimental groups included, television instruction only (TV), television instruction with ancillary support (TV+I), television instruction with parental support (TV+P), and television with both types of ancillary support (TV+I+P). Children in the control condition viewed placebo tapes.
3) Second experimental phase: Children in the TV group and the

control group were reexposed to the videotapes utilized in the first phase. This was for the purpose of equalizing the amount of exposure to the experimenter and the instructional material for all children. Children in the TV+I group received an ancillary lesson parallel to the videotape employed in the first phase. Children in the TV+P group were expected to receive a parallel lesson from their parents. Children in the TV+I+P condition received both kinds of ancillary instruction.

4) This two-phase process was repeated until all the instructional tapes and their accompanying lessons had been utilized.

Following final training:

5) All children were individually posttested 3-4 days later.
6) All children were individually tested for retention 10-14 days following posttesting.

Procedure for the Individual Studies

Seriation: Fifty-eight subjects participated in this study. The results from two sites (San Xavier and Pisinemo) had to be dropped due to failure of the paraprofessional staff to follow experimental procedure. Parent-training was not conducted as expected at either site.

The televised modeling instruction for seriation consisted of four 10-minute tapes that depicted increasingly complex instances of seriating behavior. These tapes were slight alterations of the ones used earlier in the project. Each tape consisted of a series of related segments demonstrating seriation across varied models and stimuli. In each segment a model performed some aspect of seriation and received reinforcement for correct responding. A systematic strategy of ordering by progressively selecting the longest element from a disarrayed set, removing it, adding the next longest and so on, until an ordered array was completed, was consistently modeled on every tape segment. Twice per tape the video image was frozen for 30 seconds so that the viewers could match the modeled response. Children viewed the tapes in randomly constructed dyads. An evaluation performance task was developed to assess the behavioral objectives depicted on the videotapes. The instruments were refined variations of reliable tasks used in earlier studies on the same behaviors (Henderson & Swanson, 1975). Testing was conducted on an individual basis.

The ancillary instruction consisted of four parallel lessons directly articulated to the tapes. Each lesson consisted of a modeled performance, subject match, and feedback for that match, over the relevant behavioral objectives. Stimulus materials were colorful two- and three-dimensional stimuli based on objects common in the child's environment. Ancillary instruction was also delivered in a dyad format. Parental instruction was exactly the same as the ancillary instruction except that stimulus materials were simpler and were constructed of cardboard.

A summary of the experimental phases is depicted in Table 1.

Enumeration: The terminal target behavior for this study was operationalized as the ability to discriminate on the basis of number, sets containing as many, more, or fewer objects than a comparison standard. All prerequisite skills to this three-way sorting task were incorporated into a 10-step hierarchy that proceeded from simple counting skills up to the terminal behavior. The hierarchy was broken into six segments for tape production purposes as follows: (1) counting linear manipulables with 1:1 correspondence (Tape 1), (2) counting figural materials in linear

TABLE 1

Seriation: Experimental Phases

GROUP	EXPERIMENTAL PHASES										
TV	Pretest	Tape 1	Tape 1	Tape 2	Tape 2	Tape 3	Tape 3	Tape 4	Tape 4	Post-test	Retention test
TV+I			Lesson 1		Lesson 2		Lesson 3		Lesson 4		
TV+P											
TV+I+P											
Control		Placebo 1	Placebo 1	Placebo 2	Placebo 2	Placebo 3	Placebo 3	Placebo 4	Placebo 4		

and non-linear arrangements (Tape 2), (3) matching sets by number and discriminating "same" and "different" (Tape 3), (4) acquiring the concept of more (Tape 4), (5) acquiring the concept of less (Tape 5), and (6) finally, discriminating sets as to more-same-less (Tape 6). Each tape was approximately 10 minutes in length.

Fifty-six subjects participated in this study. Again, the results from two sites had to be dropped due to failure of site personnel to follow experimental procedure.

All children were pretested on two parallel forms of the enumeration criterion-referenced instrument in the same manner as for the seriation study. Each child was assessed by a Papago examiner on an individual basis.

Following the pretest phase, children began the experimental phases. Children in the TV+I and the TV+I+P groups viewed a tape and the following day received supplementary instruction until a total of six 10-minute tapes and six equivalent lessons had been completed. Both tape viewing and supplementary instruction was conducted in randomly constructed dyads. Children in the TV+P and the TV+I+P groups also were supposed to receive a supplemental parent training session parallel to the paraprofessional instruction but employing simpler materials. Children in the TV-only condition also viewed the tapes in dyads but were exposed to each tape on two consecutive but separate occasions. Children in the control condition viewed tapes on an unrelated skill. Every child, therefore, was exposed to 12 10-minute sessions in the experimental setting.

Posttesting followed the experimental phase and was conducted individually by paraprofessional examiners. Retention testing was conducted seven to ten days following completion of the posttest phase on the same evaluation instruments.

A summary of the experimental phases is depicted in Table 2.

Conservation: The terminal behavior for this study was two-fold; the ability to solve conservation problems with equal rows (six object rows) and the ability to solve an unequal number conservation problem (five and six object rows) were included. Prerequisite behaviors included (1) pretraining on the concept of same number and 1:1 correspondence (Tape 1), (2) conservation of equality following both row-compression and row-expansion transformations (Tape 2 and 3), and (3) conservation of inequality with compression and expansion transformations (Tape 4). Each tape was approximately 10 minutes in duration. In addition to the basic modeling of appropriate conservation judgments, verbal rule provision was included and a systematic counting strategy for judgment verification was always modeled.

Fifty-nine subjects participated in this study. As in the other experiments, the results from two sites had to be dropped, one because of failure to follow experimental procedure, and the second because of failure to complete the study.

All children were pretested on two parallel forms of the conservation criterion-referenced instrument in the same manner as for the seriiation and enumeration studies. Each child was assessed by a female Papago examiner on an individual basis.

Following the pretest phase, children began the experimental phases in the same manner as in the previous studies. Children in the TV+I and the TV+I+P groups viewed a tape and the following day received supplementary

TABLE 2

Enumeration: Experimental Phases

GROUP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
TV	Pretest	Tape 1	Tape 1	Tape 2	Tape 2	Tape 3	Tape 3	Tape 4	Tape 4	Tape 5	Tape 5	Tape 6	Tape 6	Post-test	Retention test
TV+I			Lesson 1		Lesson 2		Lesson 3		Lesson 4		Lesson 5		Lesson 6		
TV+P															
TV+I+P															
Control		Placebo 1	Placebo 1	Placebo 2	Placebo 2	Placebo 3	Placebo 3	Placebo 4	Placebo 4	Placebo 5	Placebo 5	Placebo 6	Placebo 6		

instruction until all four tapes and all four lessons had been completed. As in the other studies, the parental training supplement was also offered to the children in the TV+P and TV+I+P groups. Children in the TV only condition viewed each teaching tape twice; children in the control condition viewed each placebo tape twice. Each child, therefore, was exposed to 8 10 minute sessions in the experimental setting.

Posttesting followed the experimental phase and was conducted in the same manner as the pretesting on the same evaluation instrument. Retention testing was conducted seven to ten days following completion of the posttest.

A summary of the experimental phases is depicted in Table 3.

Question-Asking: This skill did not lend itself to the task-analysis approach of hierarchically sequenced prerequisite skills as had the other target behaviors. Therefore, tapes and instructions were constructed in a different manner. In previous years the goal was to influence both fluency and flexibility in the production of causal questions. Causal questions had been defined as those beginning with the words "Why?," "How come?," or "What would happen if?," and which would request information regarding a causal relationship. That same operational definition of causal question proficiency was maintained during the third year; and those language behaviors were modeled repetitively with increasingly complex examples on the instructional tapes, in the ancillary instruction, and in the parent-training supplement.

In earlier years we had found, however, that many children acquired the causal question word, but used it to ask simple purpose type questions (e.g. "Why is this blue?") rather than relationship questions.

TABLE 3

Conservation: Experimental Phases

GROUP	1	2	3	4	5	6	7	8	9	10	11
TV	Pretest	Tape 1	Tape 1	Tape 2	Tape 2	Tape 3	Tape 3	Tape 4	Tape 4	Post-test	Retention test
TV+I			Lesson 1		Lesson 2		Lesson 3		Lesson 4		
TV+P											
TV+I+P											
Control		Placebo 1	Placebo 1	Placebo 2	Placebo 2	Placebo 3	Placebo 3	Placebo 4	Placebo 4		

Since the purpose request type question is less sophisticated than the causal question type we had operationally defined, the relationship aspect of questions were stressed in the ancillary instruction and the parent-training. Questions were considered to be appropriate structurally if (1) they began with an identified question word (2) they contained at least two nouns (3) the nouns were related with a connecting verb (e.g. "Why is the man riding a horse?"). These are the only type of questions modeled on the tapes, by paraprofessional trainers, and by the parents during their training.

Seventy-two children at the participating sites took part in the question-asking study. The pretest consisted of only one assessment form in which each item consisted of a single stimulus (object or picture) to which the subject was directed to produce a question. Question production was recorded verbatim and scored in accord with the aforementioned criteria (1 point for the question word, and 2 additional points for the noun and verb relationship.) Answers to produced questions were not provided within the assessment procedures.

Following pretest, eight experimental phases were conducted in exactly the same manner as for the conservation study. Following the eight experimental phases, posttesting was conducted with the same question production instrument and retention data was collected seven to ten days following the posttest.

The experimental phases are summarized in Table 4.

Results

Seriation: Descriptive statistics for the seriation experiment are presented in Table 5. A graphic representation of the data is presented

TABLE 4

Question-asking: Experimental Phases

GROUP	1	2	3	4	5	6	7	8	9	10	11
TV	Pretest	Tape 1	Tape 1	Tape 2	Tape 2	Tape 3	Tape 3	Tape 4	Tape 4	Post-test	Retention test
TV+I			Lesson 1		Lesson 2		Lesson 3		Lesson 4		
TV+P											
TV+I+P											
Control		Placebo 1	Placebo 1	Placebo 2	Placebo 2	Placebo 3	Placebo 3	Placebo 4	Placebo 4		

in Figure 1. The reliability of the seriation measure, as determined by the Spearman-Brown split-half method, ranged from .83 at pretesting to .96 at retention-testing. Since the second half of the test was administered three to four days after the first half, these coefficients represent stability over a short period of time as well as split-half reliability.

TABLE 5

Seriation: Means for Prettest, Posttest, and Retention Testing

Group	Pretest $\bar{X}$	Posttest $\bar{X}$	Retention $\bar{X}$
TV Only (N=11)	12.55	45.82	47.64
TV & Instruction(N=11)	10.09	55.82	58.09
TV & Parents (N=14)	12.57	66.86	58.36
Combined (N=12)	10.75	64.83	62.17
Control (N=10)	16.80	16.50	23.40

The data were analyzed with a 5 (treatment groups) x 3 (trials) repeated measures analysis of variance for unequal N. Age and sex factors were not significant in previous research with the same skills and population, and were therefore not included in the analysis. A summary of the analysis of variance is presented in Table 6.

Significant effects were found for treatments (F = 3.885, *df* 4,53, $p < .008$), trials (F = 107.684, *df* 2,106, $p < .001$), and for the groups x trials interactions (F = 5.823, *df*, 8,106, $p < .001$). Newman-Keuls post-hoc analyses revealed that the performance of the TV only group was significantly higher than the control group on both the posttest ($p < .01$) and the retention trial ($p < .05$). Television plus instruction

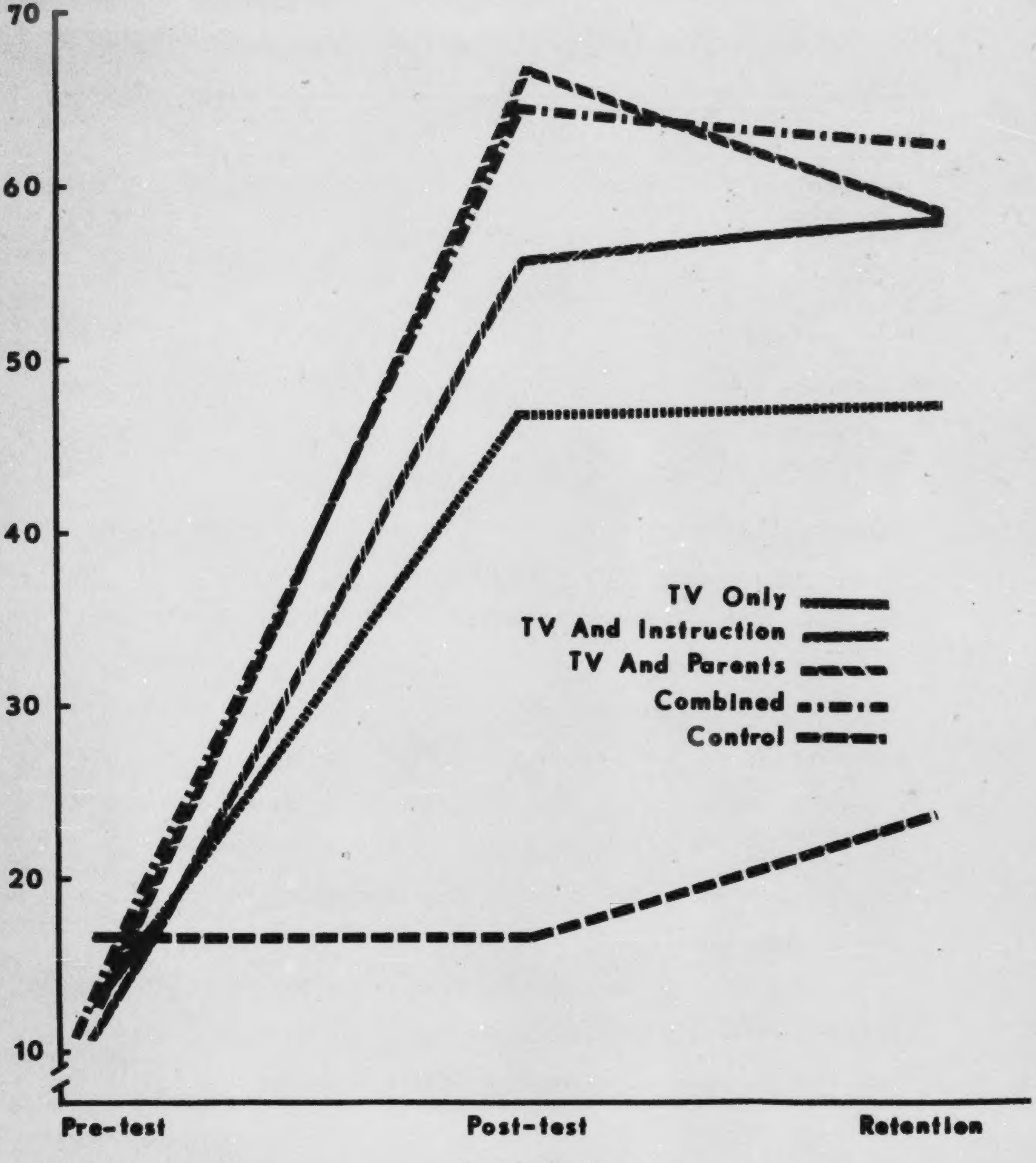

Fig. 1. Seriation

TABLE 6

Summary of Analysis of Variance for Seriation Study

Source	df	MS	F	p
Between Groups				
Treatment	4	4104.07	3.89	.008
Error	53	1056.41		
Within Groups				
Trials	2	29269.07	107.68	.001
Treatment x Trials	8	1582.74	5.823	.001
Error	106	271.80		

was significantly greater than the controls on the post and retention trials (both p's $< .01$). The TV plus parents treatment also produced significantly better performance than the control group on the post and retention trials (both p's $< .01$), and the combined treatment television plus instruction plus parents produced significantly greater performance (p's $< .01$) than the control conditions at both post and retention testing. The post hoc analysis of trials effects revealed that posttest scores were significantly higher than pretest scores ($p < .01$) for the TV only, TV and instruction, TV and parents, and combined treatment groups (all p's $< .01$). Pre, posttest and retention scores for the control group did not differ. For all of the experimental treatment groups retention scores significantly exceeded pretest scores ($p < .01$), and posttest and retention scores did not differ. For the control group, pretest, posttest and retention scores did not differ from each other. There were no significant differences between any of the four experimental groups on any of the trials.

Enumeration: Table 7 presents descriptive statistics for the enumeration experiment. Spearman-Brown splif-half reliability ranged from .85 to .90 for post and retention data. Figure 2 provides a visual display of the data.

TABLE 7

Enumeration: Means for Pretest, Posttest, and Retention Testing

Group	Pretest $\overline{X}$	Posttest $\overline{X}$	Retention $\overline{X}$
TV Only (N=10)	21.10	34.20	34.50
TV & Instruction (N=11)	18.00	35.27	36.18
TV & Parents (N=14)	20.57	41.29	40.57
Combined (N=12)	23.92	47.67	48.42
Control (N=9)	16.00	25.33	19.11

Data were analyzed with a 5 (treatment groups) x 3 (treatment groups) repeated measures analysis of variance for unequal N. A summary of the analysis of variance is presented in Table 8.

Significant main effects were found for treatments ($F = 2.43$, df 4,51, $p < .05$) and trials ($F = 70.21$, df 2,102, $p < .001$). The treatments x trials interaction was also significant ($F = 2.37$, df 8,102, $p < .02$).

Post-hoc analysis employing the Newman-Keuls procedure showed no difference among any of the treatment groups at the time of pretesting. The combined treatment group (television plus instruction plus parent support) surpassed the control group at both post ($p < .05$) and retention testing ($p < .01$).

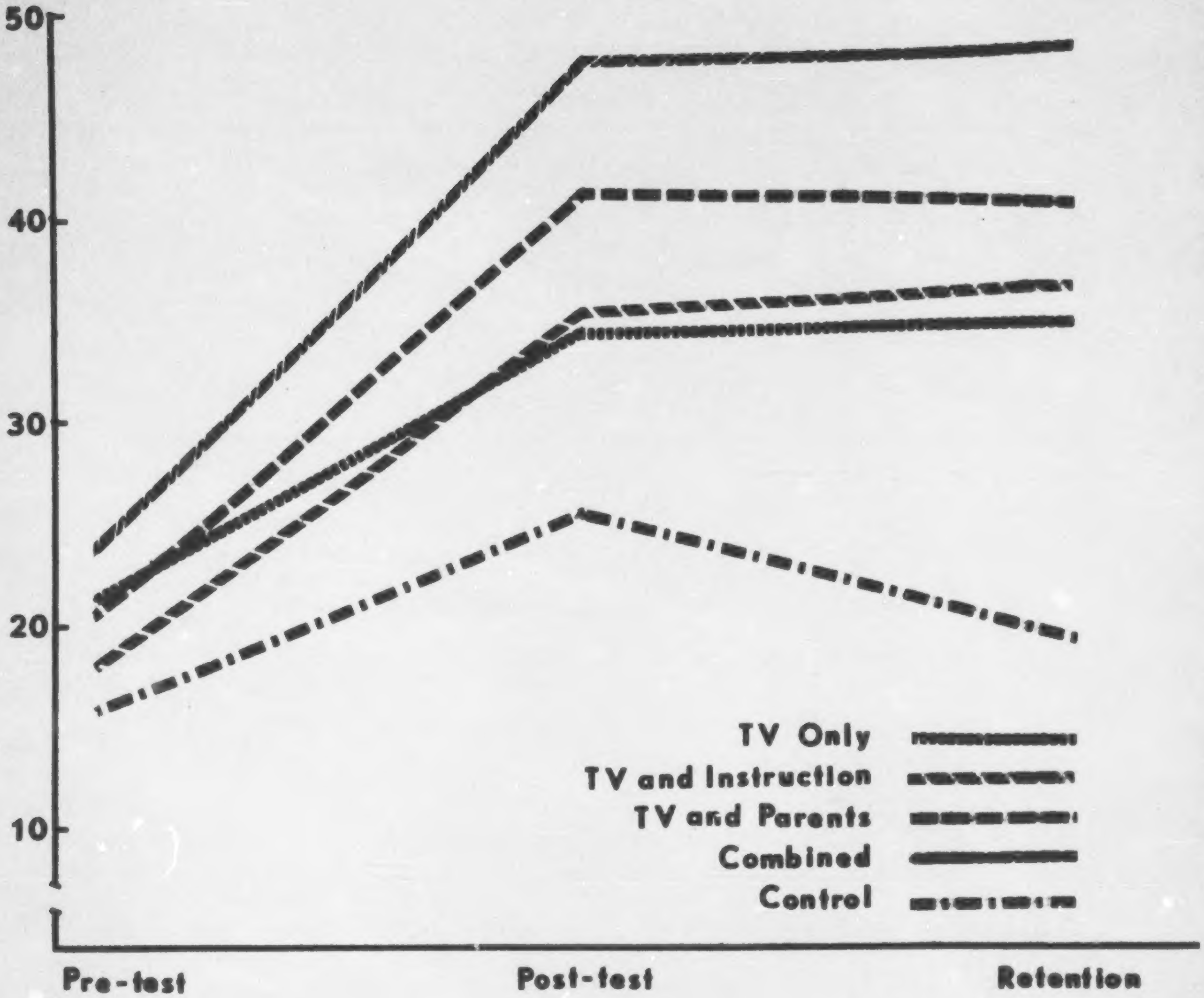

Fig. 2. Enumeration

TABLE 8

Summary of Analysis of Variance for Enumeration Study

Source	df	MS	F	p
Between Groups				
Treatment	4	1635.07	2.43	.05
Error	51	671.86		
Within Groups				
Trials	2	5471.52	70.21	.001
Treatment x Trials	8	184.29	2.37	.02
Error	102			

Post-hoc analyses across trials revealed that the combined treatment group made significant ($p < .05$) pre- to posttest gains, and for this group post and retention test performance did not differ. No other within group comparisons across trials were found to be significant.

Conservation: Descriptive statistics for the conservation experiment are provided in Table 9, and the results are presented in graphic form in Figure 3. Reliability for the conservation assessment instrument, as determined by the Spearman-Brown split-half procedure, ranged from .85 to .90.

TABLE 9

Conservation: Means for Pretest, Posttest, and Retention Testing

Group	Pretest $\overline{X}$	Posttest $\overline{X}$	Retention $\overline{X}$
TV Only (N=13)	7.23	10.85	13.00
TV & Instruction (N=12)	6.33	10.08	9.42
TV & Parents (N=12)	6.08	14.58	14.33
Combined (N=11)	7.09	15.27	15.73
Control (N=11)	5.09	7.91	5.36

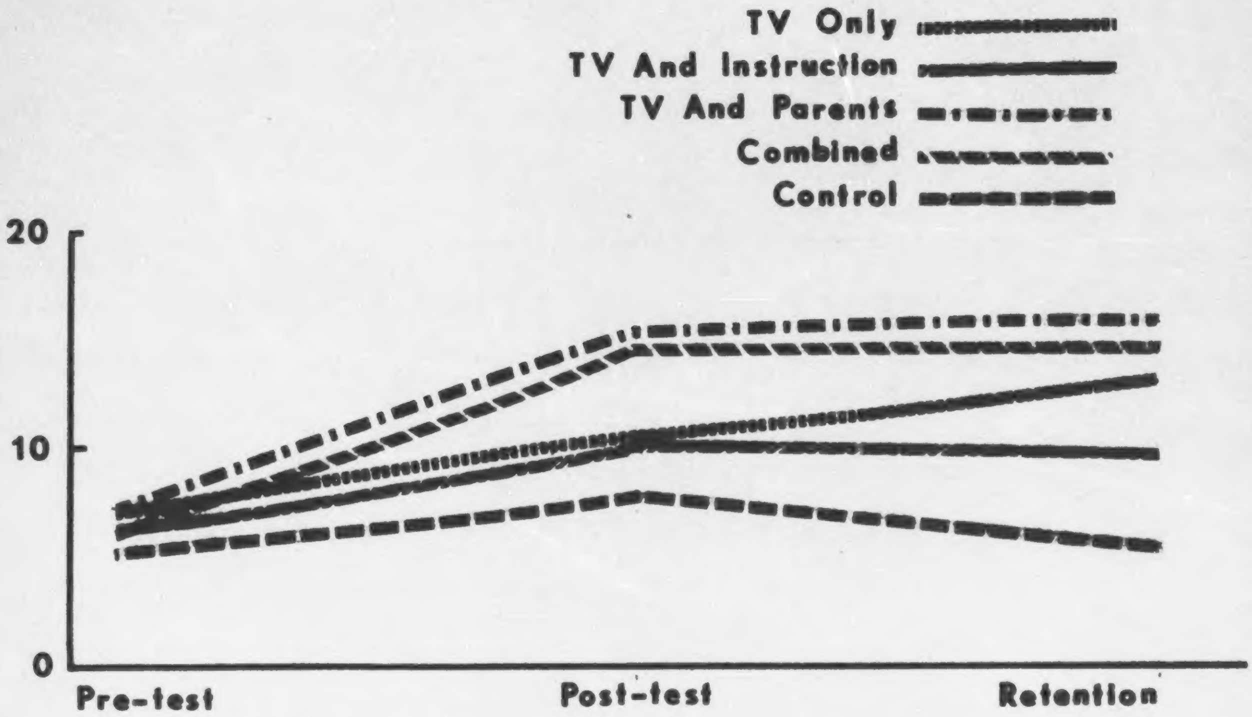

Fig. 3. Conservation

The data were analyzed with a 5 (treatment groups) x 3 (trials) repeated measure analysis of variance for unequal N. A summary of the analysis of variance is presented in Table 10.

TABLE 10

Summary of Analysis of Variance for Conservation Study

Source	df	MS	F	p
Between Groups				
Treatment	4	227.43	1.847	.132
Error	54	123.14		
Within Groups				
Trials	2	550.12	19.862	.001
Treatment x Trials	8	43.89	1.585	.137
Error	108	27.70		

The only significant finding was for the trials main effects (F = 19.86, 2,108, $p < .001$). Post-hoc comparisons emphasizing the Newman-Keuls test revealed only one significant difference. The retention scores of children in the combined treatment group exceeded reretention scores of the controls ($p < .05$).

Question-Asking: Descriptive statistics for the question-asking study are presented in Table 11. The reliability of the question-asking measure, as determined by the Spearman-Brown split-half method was .99 at both post and retention testing. The data are displayed graphically in Figure 4.

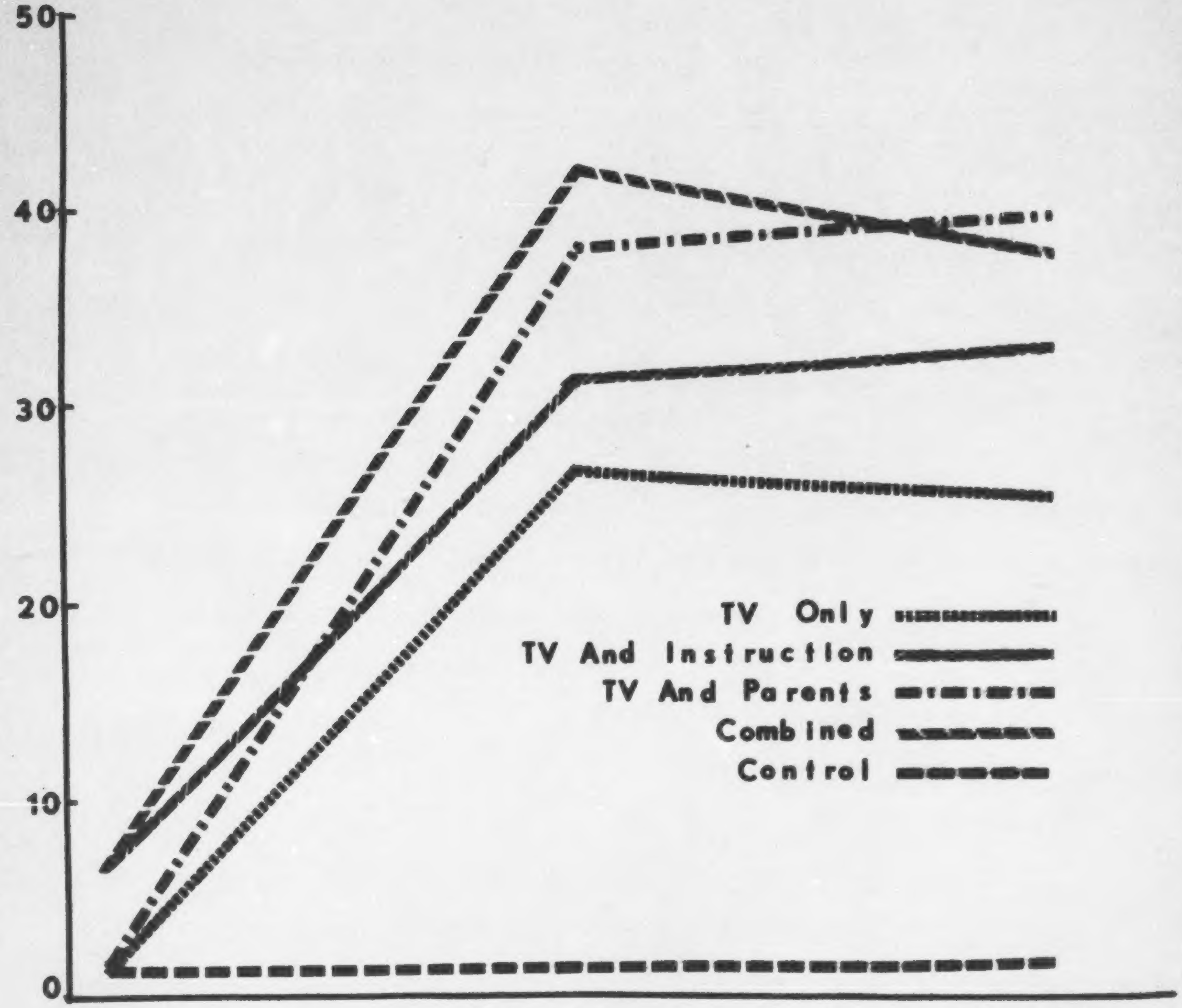

Fig. 4. Question-Asking

TABLE 11

Question-Asking: Means for Pretest, Posttest, and Retention Testing

Group	Pretest $\bar{X}$	Posttest $\bar{X}$	Retention $\bar{X}$
TV Only (N=16)	1.38	26.75	25.19
TV & Instruction (N=14)	6.64	31.07	32.86
TV & Parents (N=14)	1.71	38.21	39.64
Combined (N=13)	6.69	42.23	37.69
Control (N=15)	1.47	1.67	1.80

The data were analyzed with a 5 (treatment groups) x 3 (trials) repeated measures analysis of variance for unequal N. A summary of the analysis of variance is presented in Table 12.

TABLE 12

Summary of Analysis of Variance for Question-Asking Study

Source	df	MS	F	p
Between Groups				
Treatment	4	5163.21	16.98	.001
Error	67	309.21		
Within Groups				
Trials	2	13471.1	138.175	.001
Treatment x Trials	8	1025.39	10.518	.001
Error	134	97.49		

Significant main effects were found for treatments (*F* = 16.698, *df* 4,67, *p* < .001) and trials (*F* = 13471.1, *df* 2.134, *p* < .001) and for the trials by treatment interaction (*F* = 10.518, *df* 8,134, *p* < .001).

Newman-Keuls post hoc analysis revealed no differences among the treatment groups at the time of pretesting. All of the experimental treatment groups exceeded the control group on both post and retention trials ($p < .01$). In the posttest the combined treatment surpassed the television only treatment ($p < .05$) and the television plus parent treatment surpassed the television only treatment on the retention trial ($p < .05$). No other significant differences were revealed among the various experimental treatment groups.

Newman-Keuls post hoc analysis of performance across trials revealed no differences between post and retention trials for any of the experimental groups ($p < .01$). Posttest and retention results significantly exceeded the pretest performance for all of the experimental groups ($p < .01$). There were no differences across trials for the control group.

DISCUSSION

In general, the results of the experiments conducted during the life of this grant have demonstrated that televised instruction based on social learning theory and task analysis can be effective in teaching abstract rule-governed behaviors to preschool children. The work has also demonstrated that under certain conditions simple ancillary support provided by a paraprofessional or a parent may enhance the effects of televised instruction alone. Nevertheless, there are many qualifications to be added to these general conclusions and these qualifications hold implications for both cognitive-developmental theory and for instructional applications of television.

Two of the experiments conducted during the first year of the grant were very successful. The results of the seriation experiment were highly significant and also demonstrated practical significance. Practical significance was demonstrated by the fact that most of the children involved in the experimental group made substantial gains in seriation skills. Therefore, it is clear that the significant results were not attributable to a few children making marked gains. The question-asking study conducted during the first year also produced results with both practical and statistical significance. These outcomes offer support to the social learning position which holds that children abstract linguistic rules from the regular speech utterances of models in the environment. Gains were made by 83% of the experimental children and 67% of these children gained 20 points or more. The individual responses of children were highly varied and most clearly revealed that the children were not simply mimicking the model.

The results of the second year's experimentation showed that the effects of televised instruction were significantly enhanced when paraprofessionals were trained to provide brief activities which presented children with the opportunity to practice the behaviors which they had observed demonstrated by televised models. In earlier studies in the social learning tradition, model provision and reinforcement of the subject for incremental modeling responses have been confounded. The present research demonstrated that children who are given the opportunity to engage in imitative responding on a verbal task, such as question-asking, ask significantly more questions than children exposed to televised modeling only. In this research, we were not able to separate the contributions of participation and reinforcement for responding because the available sample size was inadequate to provide for an additional experimental treatment. Therefore, the specific effects of these two separate variables remain to be explored.

Three of the studies conducted during year two of the grant investigated the influence of television with and without ancillary support on tasks which are generally considered to reflect concrete operational thought in young children. These tasks were seriation, enumeration, and conservation.

In the seriation experiment children who were exposed only to televised instruction performed as well as children who were exposed to television instruction plus guided performance provided by a trained paraprofessional. There were no differences in the degree to which younger children learned from the experimental treatments as compared to the older children. These results were particularly interesting in contrast to the results of the enumeration and conservation experiments. In the enumeration experiment we found that for the older preschool children televised instruction alone was just as effective as the combined treatment. In contrast, the younger children learned with the enumeration task only when televised instruction was supplemented by ancillary support consisting of guided performance provided by a trained paraprofessional. The conservation experiment revealed a different pattern yet. For the conservation task, neither television alone nor television plus ancillary support was effective in teaching the younger children to perform the seriation tasks. For the older children, both the television only and the television plus ancillary support treatments were effective. These results provide some support for Piaget's assertion that the child's own activity facilitates the development of operational concepts.

When the seriation, enumeration, and conservation experiments are considered in relationship to one another, the results strongly suggest that the visual perceptual qualities of the task to be performed have an important influence on the child's ability to learn the rule observationally. In the case of seriation there is a direct correspondence between the visual configuration of an array of objects and the judgment that the objects are either ordered or not ordered correctly. In the enumeration tasks, the perceptual qualities of the stimulus arrays neither facilitate the child's correct judgment nor confound his responding. The perceptual qualities of the enumeration task are somewhat irrelevant to the correct response. This is not the case with conservation in which perceptual cues are deliberately confounded with number. The coexistent length and numerosity dimensions of the task directly contradict one another. Therefore, it is necessary for the child to disregard the visual perceptual cues in order to make a correct response. Piaget attributes this difficulty in solving conservation problems to the lack of the young child's ability to coordinate two attributes simultaneously. Recent research, however, has suggested that children are able to coordinate two verbal attributes at a younger age than it is possible for them to coordinate a verbal or judgmental attribute and a visual attribute. It appears that the visual attribute is so salient that the child is unable to ignore it.

These results suggest that different instructional programming approaches may be needed for the concepts with different characteristics. It also suggests that young children may learn some concepts, expecially those that present a high degree of congruity between visual perceptual qualities and the defined attributes of a concept. It also seems clear that the age of the targeted audience is another factor that must be taken into consideration in making decisions about televised instruction. Some concepts may be taught effectively with television alone to preschool children, while other concepts may require some kind of guided participation directed by an adult.

Upon initial inspection the results of the third year's work seem difficult to explain. None of the treatments were effective for the conservation skill, whereas in previous experiments conservation had been taught effectively at least for the older half of the sample. In the question-asking, seriation, and enumeration studies performance of children who were exposed to televised instruction was significantly superior to control groups. However, in only one of these experiments, enumeration, was a condition involving ancillary instruction more effective than television only. In the enumeration experiment in which children whose parents provided them with supplementary activities or who were guided in their performance by paraprofessionals as well as by their parents achieved to a significantly higher degree than those who witnessed television only.

These results should be viewed within the context of the field situation for the third year of the grant. During the third year of the grant, experiments were carried out in five communities on the Reservation. Some of these communities were more than 150 miles (one-way) from the University. The fact that the staff was spread over five communities rather than three and involved in the training of parents as well as serving as paraprofessionals spread project resources extremely thin.

Indigenous paraprofessionals were employed to act as parent trainers and experimenters in each of the Reservation communities, but because of the distances involved it was much more difficult to monitor activities as rigorously as had been done during the first two years of the study. Quality control data suggests that the rigor with which on-site personnel carried out their responsibilities varied greatly both across sites and within individuals whose performance fluctuated from time to time. Moreover, it became apparent that in these circumstances of geographical isolation those parents to whom field staff had easy access were provided with more and apparently better training than those parents who were more difficult to reach.

There is a consistent trend throughout all of the third year studies for those instructional treatments involving the use of ancillary support by parents or by paraprofessionals or both to be superior to the effects of television instruction alone. In all except the enumeration experiment the error terms were so large that the differences did not attain statistical significance. Nevertheless, the consistency in this trend is highly suggestive and in a sense the question-asking, seriation, and enumeration experiments approximate three replications of an instructional approach focused on differing conceptual behaviors. It seems particularly noteworthy that there was a consistent tendency for children whose parents supplemented the television viewing to perform at a higher level than those who sought television only. It seems highly likely that with better procedures to control the quality of instruction provided for parents, and with improved techniques for regularizing the time spent with their children, parental support of children's viewing of instructional television may be effective.

FURTHER EXPLORATIONS OF THEORETICAL AND EMPIRICAL ISSUES

In general terms, the data from this project have shown that televised programming can be very effective in helping children to acquire certain kinds of complex cognitive skills. We also know that the effectiveness of the TV medium depends upon such other factors as the nature of the concept presented, the age of the target audience, the opportunity to practice skills presented on TV, and to receive feedback on that performance. For some concepts practice guided by an adult, who may be a trained parent or a paraprofessional, facilitates acquisition and retention of concepts. The effectiveness of this supplemental instruction also depends upon the age of the child.

While these findings indicate that complex rule-governed behaviors can be taught to preschool children with television, and that for the more complex concepts ancillary support enhances learning, in the research originally proposed and conducted it was not possible to sort out the effects of the several variables that were incorporated into the programming. This was to be expected, since our original purpose was to make the programming as powerful as possible, and to do so we combined as many principles as seemed likely to enhance the effectiveness of the presentations. For both practical and theoretical reasons it is important to sort out, to a greater extent than we originally proposed to do, the differential influences of various instructional elements. A no cost extension to the original grant was obtained to explore some of these issues.

During the no-cost extension period (June 30, 1976 to February 29,

1977) we completed a study of the effects of learner activity and feedback on the acquisition of Piagetian conceptual skills. In this study we were able to address a question relevant to Piaget's theory that has direct implications for children's television programming. We examined the relative influences of observation alone, imitative motor activity, and feedback on the induction of a Piagetian task -- seriation. Piaget's theory posits that preschool children would require motor performance to learn such responses, while social learning theory suggests that imaginary rehearsal should be sufficient to code the observed performance for later use.

We were also concerned that most research on instructional television has employed either a testing, treatment, posttesting strategy, or a posttest only design, with little or no attention being given to the actual behaviors children engage in while viewing. The few investigations that have studied viewing behavior have been limited to looking at the child's visual attention. One exception is the work of Luis Laosa (1976), which suggested that visual attention may be a very poor indicator of a child's actual attention to the televised message. His study identified relationships among a number of relevant viewing behaviors, but he did not determine whether these behaviors are related in any way to learning outcomes. He also examined the viewing behaviors of children only in a single viewing condition (groups of six), so we do not know if the behaviors recorded are dependent to any degree on the nature of the social situation. Therefore, a study of the relationships among television viewing behaviors, social setting, and learning outcomes among preschool children was initiated. Funds from the no-cost extension of this OCD grant were sufficient only to assist in the collection of observational data. The remainder of the research was supported from other sources. This study is not yet completed, but a preliminary analysis has been conducted.

The results of the study of influences of observation, imitative motor activity, and feedback on the induction of a Piagetian concept are presented in the following section. In the final section of the report preliminary results of the study of relationships between viewing behaviors, social settings, and learning outcomes will be summarized.

The Relative Influence of Observation, Imitative Motor Activity, and Feedback on the Induction of Seriation*

Training research on children's acquisition of conceptual behaviors in general and Piagetian concepts in particular has proliferated in the recent past to the point of redundancy. Various training procedures have been successful (Brainerd, 1973), although virtually all constitute what Brainerd has referred to as "imitative motor training" of one kind or another (Brainerd & Heuvel, 1974, p. 99). While it may no longer be topical to demonstrate that pre-operational age children can be trained to accomplish a concrete operational task, the specific processes through which such concept facilitation is accomplished remain a clouded issue.

The provision of performance models is one procedure that has been verified as a powerful learning facilitator in research on concept acquisition. There is an extensive literature in the social learning tradition which suggests that models are effective in teaching abstract rule-governed behavior (Zimmerman & Rosenthal, 1974b). Such cognitive behaviors as language responses have been facilitated through modeling procedures (Bandura & Harris, 1966; Liebert, Odom, Hill & Huff, 1969; Odom, Liebert & Hill, 1968; Carroll, Rosenthal & Brysch, 1972; Harris & Hassemer, 1972), as has inquiry response induction (Rosenthal & Zimmerman, 1972b; Henderson & Garcia, 1973; Henderson, Swanson & Zimmerman, 1975; Zimmerman & Pike, 1972). Piagetian tasks such as conservation (Rosenthal & Zimmerman, 1972a; Zimmerman & Rosenthal, 1974a), classification skills (Denny & Acito, 1974), and seriation behaviors (Henderson, Swanson & Zimmerman, 1975b; Swanson & Henderson, 1976) have all been facilitated through the use of vicarious concept induction. However, with respect to the vicarious training of Piagetian concepts, the modeling treatment is for the most part a highly complex, molar instructional unit including not only observation but subject activity and feedback (vide Zimmerman & Rosenthal, 1974a; Henderson, Swanson & Zimmerman, 1975b). The successful results of these studies, therefore, shed little further light on the specific induction variables that are critical to the process of concept acquisition.

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*This report is based on a dissertation submitted by Rosemary A. Swanson to the Department of Educational Psychology, University of Arizona, 1976.

According to Bandura's (1969, 1971) analysis of behavioral acquisition in an information processing model, there are two sets of processes (i.e. attentional and retentional processes) that affect whether or not a specific behavior will be encoded and retained by an observer. The variables that are considered relevant to the acquisition phase of learning include those that affect the manner in which the observer will attend to a model display, code that display in some informative fashion, and recall that constructed code at a later time to guide performance. In terms of the acquisition of a cognitive behavior (Zimmerman & Rosenthal, 1974b), the observer abstracts a conceptual rule to guide his performance from viewing a series of modeled exemplars. In this theoretical analysis, it is not necessary for the observer to engage actively in the task, nor is it necessary for the observer to receive any direct feedback. Observation and abstraction from the performance of another person is a sufficient condition to induce concept acquisition.

On the other hand, from a Piagetian perspective, observation alone would not be viewed as a sufficient condition to induce a concrete operational concept. The child must actively engage in manipulation of concrete stimuli to discover object relationships; the child must take an active part in the learning rather than being a passive receiver of information (Flavell, 1963). Successful training procedures have consisted of some form of eliciting active operational practice (Brainerd & Heuvel, 1974).

The problem concerns the fact that attempts to train concrete operational concepts from observation have most often also included activity on the part of the subject, and often feedback to the subject for that activity. Typically the child observes a model performing a rule-governed behavior and then immediately makes an overt response on exactly the same task as used in training, either as an immediate post-test or as part of the treatment condition. This active responding occurs prior to an examination of rule-governed behavior on any kind of generalization or transfer task (vide Zimmerman & Bell, 1972; Zimmerman & Rosenthal, 1974a; Henderson, Swanson & Zimmerman, 1975b). With this approach it is impossible to determine whether it is the modeling display or the overt matching response that facilitated rule abstraction. Hence, these variables have not been examined in an unconfounded manner.

Seriation is one specific Piagetian task that has been successfully trained with modeling procedures (Henderson, Swanson & Zimmerman, 1975b; Swanson & Henderson, 1976) but modeling was confounded with an active response component. The specific causal role of activity in relation to the acquisition of seriation is not at all clear. The present study is addressed to the problem of unconfounding the variables of observation, activity, and feedback on the sample concrete operational behavior of seriation.

Evidence from modeling studies on concrete operational conceptual behaviors other than seriation does not help a great deal to clarify the issue. McLaughlin & Brinley (1973) used both modeling and practice conditions to train children on a multiple-classification task. While modeling was effective in altering performance on a duplicate task, the investigators were unable to detect differences between the effects of practice and the effect of a model. Furthermore, there was no support that modeling was an effective procedure in facilitating abstraction to a novel but related task for the youngest group of children. The proposed process of rule-abstraction and generalization from modeling (Liebert & Swenson, 1971a; 1971b) cannot be unequivocably supported from the McLaughlin & Brinley (1973) study. In a modeling study of conservation behavior (Zimmerman & Rosenthal, 1974a), the treatment not only included observation but matched active responding as well. It is difficult to determine, therefore, whether it was the modeling display or the overt matching response that facilitated rule abstraction.

The role of subject activity is also theoretically relevant to the development of imagery. Both social learning theory and Piagetian theory propose that an imagery process is related to cognitive behavior. In social learning theory some sort of coding is the proposed process through which an observer retains information included in a model display (Bandura, 1969). Imaginal coding could perform that retentional function for later response production. In Piagetian theory, imagery that can represent transformations is characteristic of the competencies of the concrete operational child (Piaget & Inhelder, 1971). Both positions assume a positive relationship between the ability to produce an image and subsequent performance. However, Piaget asserts that imagery is the result of internalized motor activity, and specifically, internalized imitative motor activity (Brainerd & Heuvel, 1974). The imaginal code relevant to modeling is more of a perceptual template reminescent of Bruner's ikonic representation (Bruner, 1968) that could be utilized to guide a performance match, but which results from perceptual rather than motor activity processes. Imitative training techniques have been demonstrated to be effective in inducing concrete operational concepts, and imitative motor activity was more effective than non-motoric imitation (observational) or discrimination training (perceptual) in training children to recognize and produce geometric shapes (Brainerd & Heuvel, 1974). Moreover, in the Brainerd & Heuvel (1974) study, the capactiy to represent geometric shapes was positively correlated with the ability to perform concrete operational behaviors.

Imaginal coding processes appear to be particularly relevant to seriation behaviors, because at least with respect to length seriation, perceptual characteristics of the stimuli create what Piaget has called "facilitating conditions" (Baylor & Le Moyne, 1966) not apparent with other concrete operational tasks. If images can be abstracted from perceptual characteristics, then observation should prove sufficient; if however, subject activity is necessary to promote imaginal processes, observation alone should prove to be inadequate.

This discussion indicates that subject activity is an important variable to consider in examining movement from the preoperational to the concrete operational stage of development. If so, any training or concrete operational induction procedure utilizing modeling principles must certainly control for the influence of overt subject activity on concept acquisition if one wishes to attribute change to observation alone. This has not been clearly separated and examined in such training studies.

In order to examine the role of activity in concept acquisition, the influence of feedback as a result of activity from activity itself must be isolated. The modeling studies of seriation have included the activity plus feedback component (Henderson, Swanson & Zimmerman, 1975b; Swanson & Henderson, 1976). In a modeling study of conservation (Zimmerman & Rosenthal, 1974a), the modeling condition was compared with modeling plus corrective feedback and corrective feedback alone. Both groups that were exposed to a correction component exceeded the model only condition. Bandura (1969, 1971) has indicated that feedback is not a necessary condition for learning to occur, but in addition to isolating the activity dimension from the modeling influence, it seems advisable to separate the feedback variable with respect to activity as well.

The purpose of the present study was to separate observational concept induction from the confounding variables of subject activity and feedback for subject activity in training very young children in the sample concrete operational task of seriation. It was anticipated that the subsequent results would help to illuminate some of the process variables that at this point remain unclear.

Method

Subjects: The subjects who participated in this research study were 40 preschool children who attended a private day care center servicing a predominately middle-class population in a metropolitan area in the Southwest. The subject group consisted of 20 girls and 20 boys ranging from 3 years, 0 months to 4 years, 2 months in age, with a mean age of 3 years, 6 months. Subjects were randomly assigned to one of four treatment groups, three of which received vicarious instruction presented via a video display in the concept of seriation while the fourth received similar televised instruction in an unrelated conceptual task.

Procedure: Materials and Scoring--The televised modeling instruction materials and scoring for the seriation training consisted of four 10-minute tapes that depicted increasingly complex instances of seriating behavior. These tapes were slight alterations of training tapes used in earlier experiments (Swanson & Henderson, 1976; Henderson, Swanson & Zimmerman, 1975b). Each tape consisted of a series of related segments demonstrating seriation across varied models and stimuli. In each segment a model performed some aspect of seriation and received reinforcement for correct responding. Every segment was parallel in this respect and parallel in that the relevant rule was held constant while all non-relevant dimensions were systematically varied. A systematic strategy for ordering by progressively selecting the longest element from a disarrayed set, removing it, adding the next longest and so on, until an ordered array was completed, was consistently modeled on every tape segment. Twice per tape, the video tape was frozen for 30 seconds on a clear close-up visual image so that children in the activity treatment groups could match the modeled responses.

An evaluation performance task was developed to assess the behavioral objectives depicted on the videotapes. The instrument was a refined variation of a reliable task (r's > 90) used in earlier studies with the same behaviors (Swanson & Henderson, 1976; Henderson, Swanson & Zimmerman, 1975b). The assessment instrument consisted of 12 test items, four of which required the child to make size discriminations, and eight of which required the child to seriate a disarrayed set comprised of from four to six stimulus items. One point was given for each correct size discrimination while three points were given for a seriation performance. Size discrimination was weighted with a lower value since it was viewed as a prerequisite to seriation rather than as an index of seriation behavior. In addition, since the least complex level of seriation tasks (i.e. ordering of three linear objects) was not included between the prerequisite skill of size discrimination and a complex seriation performance, the complex tasks were weighted more heavily. In order to systematically order a four-object array, three size discriminations are required, hence the assignment of a three-point value for assessment items requiring at least that complex a task. To be considered an acceptable seriation performance, the subjects not only had to order the array, but had to order it in a systematic manner rather than through a trial and error approach. Only performance of the conceptual behaviors was considered; verbal justification was not included to avoid a confounding of performance with language facility. Stimulus objects utilized in assessment consisted of two and three dimensional objects other than the specific ones included in the video display.

Treatment variations--Following random assignment to a treatment group, all children were pretested individually on the seriation assessment instrument. Each child was then exposed, on an individual basis, to the four training tapes on consecutive days. Delayed posttesting was conducted two to three days following the final tape viewing in the same manner as the pretesting. Retention testing was conducted 7-10 days after posttesting.

Modeling and Covert Rehearsal: The children (n = 10) in the seriation modeling and covert rehearsal group viewed all four of the training tapes. However, twice per tape, the video was frozen for 30 seconds to allow for covert rehearsal. This involved the experimenter instructing the child to"make a picture in your head of you doing what [TV character] just did." To insure that each child understood this direction, one practice session was conducted prior to any tape exposure. Each child in this condition participated in eight such covert rehearsals during the course of the experiment. No feedback for this rehearsal task was provided.

Modeling Plus Overt Rehearsal: Subjects in this condition (n = 10) viewed the same tapes. When the tapes were frozen, however, the subject was instructed to "do what [TV character] just did" and was provided with duplicate stimulus items as those utilized by the video models. Again, feedback was not provided for that overt response. Eight opportunities for a matching active response were provided during the course of the experiment.

Modeling Plus Overt Rehearsal and Feedback: Subjects in this condition (n = 10) received precisely the same instructions and experience as those in the modeling plus overt rehearsal group with the addition that the experimenter did provide brief informative feedback concerning the correctness of the matching response.

Control: Children in the last condition (n = 10) viewed four tapes of equal duration on a non-related task.

Results

The data were analyzed using a 4 (treatment group) x 3 (trials) repeated measures analysis of variance for equal n's. Descriptive statistics for the treatment groups are presented in Table 13, and a summary of the analysis of variance is presented in Table 14.

TABLE 13: MEAN AND STANDARD DEVIATIONS FOR PRETEST, POSTTEST, & RETENTION TRIALS

	Pre		Post		Retention	
Group	M	SD	M	SD	M	SD
Modeling & covert rehearsal	2.8	1.4	9.0	4.7	9.5	6.8
Modeling & overt rehearsal	4.3	1.8	13.6	8.5	15.2	8.9
Modeling & overt rehearsal & feedback	3.7	.5	17.3	8.7	17.6	11.2
Control	3.3	.8	5.7	2.8	5.9	2.5

Significant effects were found for groups, _F_ (3,36) = 36.12, $p < .005$, for trials, _F_ (2,72) = 37.96, $p < .001$, and for the groups x trial interaction, _F_ (6,72) = 3.32, $p < .01$. The trials effect was still significant ($p < .001$) when Box's correction was employed (Myers, 1972).

TABLE 14: SUMMARY OF ANALYSIS OF VARIANCE

Source	df	MS	F	p
Between groups				
treatment	3	389.63	36.12	<.005
error	36	63.69	-	-
Within groups				
trials	2	900.75	37.96	<.001
groups & trials	6	78.78	3.32	<.01
error	72	23.73	-	-

Newman-Keuls post hoc comparisons were utilized to examine specific effects. Pairwise comparisons indicated no significant differences among the groups on pretest, no significant gain for the control group or for the modeling plus covert rehearsal group, and no significant difference between the control and modeling plus covert rehearsal condition. The modeling plus overt rehearsal condition did lead to significant pre to post and post to retention trials gain ($p < .01$), and a significant advantage over the controls at both post ($p < .05$) and retention ($p < .01$). The difference between modeling plus overt rehearsal and modeling plus covert rehearsal approached a statistically significant advantage for the former at retention ($p < .10$). The modeling plus overt rehearsal and feedback group also produced a statistically significant gain from pre to post and pre to retention trials ($p < .01$) surpassing both the control ($p < .01$) and the modeling plus covert rehearsal group ($p < .05$) at both post and retention. The modeling plus overt rehearsal condition and the modeling plus covert rehearsal and feedback did not differ significantly from one another, and neither demonstrated any significant drop from post to retention trials.

Test-retest reliability between post and retention trials for the evaluation instrument produced a Pearson Product-Moment correlation of .83.

Discussion

The results of the study undertaken here are clear and unambiguous with reference to the differential effectiveness of the training procedures with this skill and with this particular population of preschool children. While the precise theoretical ramifications are not as unequivocal, these results do raise a number of important questions and provide implications for future study that could serve to clarify some of the remaining ambiguity centered around this issue.

It is clear from the results obtained that while observation alone did not yield any significant gains, both modeling plus activity and modeling plus activity and feedback led to impressive gains that were durable over a two-week period with children this young. Both of the activity groups surpassed the controls, and while they did not differ significantly from each other, only the modeling plus activity and feedback condition displayed a significant advantage over modeling alone. It does seem evident that active motor involvement on the part of the subject played an important and perhaps critical role in assuring seriation performance.

The results are consistent with the Piagetian view that subject activity of an imitative nature is critical to cognitive development and that reinforcement or corrective feedback appears to be irrelevant. One could argue that activity is an important dimension, not specifically because the learner is active in the acquisition process, but rather because actively engaging in the production of a response permits the learner to receive feedback from the environment as to the correctness of his own response. Social learning theorists have emphasized the role of reinforcement contingencies on the performance of acquired responses (Flanders, 1968; Bandura, 1969,1971) and would no doubt predict that the reinforcing function of feedback would lead to a more proficient performance on a task such as this. However, in this study the subjects receiving such feedback failed to demonstrate an added advantage over those who were only active without the addition of feedback.

The differences in experience provided between the observation only condition and the activity condition are very similar to the differences noted in the Brainerd & Heuvel study (1974) where imagery production was the dependent measure. In that case the subjects in the observation treatment attended to the experimenter's production of a clear visual image; such was the case in this study. In the former study the activity group copied the experimenter-produced image; again the same process was conducted here. The results are also parallel in that the activity groups both performed in a superior fashion. Since comparability of results on tasks that are different in terms of topography but similar in terms of operativity is suggestive of the importance of processing of information from differential experience.

From a Piagetian perspective, activity is a critical aspect of the development of cognitive processes (Flavell, 1963). One possible reason is that the subject's motor involvement facilitates imagery; success at imagery tasks has been found to correlate with performance of concrete operational tasks such as seriation (Brainerd & Heuvel, 1974). Active matched responding then serves to generate an imaginal code conducive to appropriate responding on the conceptual task. It is the process of acting that is important in this view rather than the product of the action. This explanation is consistent with the results obtained here in that activity did result in a superior performance not exceeded by the addition of feedback for the products of activity. If, on the other hand, the simple provision of a visual image that is attended to and retained is sufficient to promote imaginal coding then the observation-only subjects were provided with such a code, did attend to it, and should have performed as well as subjects generating their own visual code. This did not occur. These results suggest, that the learner must be active, perhaps must be his own imagery generator.

The results of this study do not clearly elucidate precisely why activity results in demonstrable gain. They do clearly reveal that observation alone is not sufficient for concept induction; the learner needs to be involved for maximal benefit. Whether or not activity plays a lesser role with increased exposure to vicarious exemplars, or whether the advantage for activity decreases with increasing age, are important questions that still remain for investigation.

From a practical orientation as well as a theoretical perspective, it is clear that the more environmental factors that can be included in instruction designed to support concept attainment, the more powerful the induction procedure. Hence, the least powerful in terms of environmental support, modeling alone, yields the lowest performance; the most powerful, coupling vicarious as well as direct influence, results in the highest yield.

Relationships Among Viewing Situations, Viewing Behaviors and Learning Outcomes

Existing studies of the relationship between attention to television and learning outcomes resulting from viewing have been limited to studies of visual attending. Some of these studies have been very sophisticated (e.g. Mock 1976; O'Bryan, 1976), but Laosa (1976) has recently presented data which suggest that visual attention may not be the best indicator of whether or not viewers are processing the televised message. Laosa's study examined the viewing behaviors of first, second, and third-grade children during the presentation of two Carrascolendas pilot programs. The viewers were Anglo American, Mexican American, Puerto Rican and Cuban Americans. Viewing behaviors included visual attention, facial expressions of mirth, verbal and nonverbal imitations, and program- and nonprogram-related verbalizations. One of the principal findings was that eye contact is not an adequate indicator of attention when it is used as the sole measure of program appeal or attention. The results suggested that children may be deeply engaged in attending to the televised message even when they are not watching the screen continuously. One purpose of the present follow-up study was to determine the relationship of a varied range of viewing behaviors, as suggested by Laosa's research, to learning outcomes. Since the tapes produced for this grant have proven effective in teaching such skills as seriation, they seemed appropriate for this purpose.

The second major purpose was to determine the effects of viewing alone and in groups comprised of different numbers of children. Most of the research conducted so far under our grant from OCD involved single viewers, and we do not know if such instructional programming is effective with larger numbers of children. During the third year of research, students did view in groups of two, but because the number of subjects available for study was limited, it was not possible to make a direct determination of whether viewing in dyads differs in effectiveness from viewing singly. In the present study the size of the viewing group was varied. Children viewed singly, in dyads, or in groups of four.

Method

Subjects: Children from three preschools were randomly assigned to one of three viewing conditions: viewing alone, in dyads, or in groups of four. For this preliminary analysis complete data sets were available for 45 children in the single viewing condition, 43 children in the dyad viewing condition, and 44 in the condition with four viewers. The children were predominately from middle- and upper-middle-class families, with a few children from working class families and some from families headed by full-time university students. Almost all of the children were Anglo Americans.

Procedures: Children in the various viewing conditions watched the seriation tapes that were used in the main study of seriation conducted during the third year of the research. These tapes were described earlier in this report. The series consists of four tapes which were viewed on successive days, often with one or two days intervening between successive viewings. This variation was the result of scheduling considerations at the individual preschools, and because of student absences. During each viewing session the children's viewing behaviors were observed and coded with a modified version of the observational instrument used by Laosa (1976). In the single viewer and dyad viewing conditions the observer sat diagonally across the room, where the facial expressions and gestures of the children could be observed. In the condition with groups of four viewers, the children were seated in a semi-circle facing the television set, while two observers recorded viewing behaviors. Each observer was responsible for coding the behavior of two children. Observers were pretrained to an inter-rator agreement level of 95% for each observational category. Random reliability checks were conducted during the entire course of the data collection phase, with levels of agreement ranging from 90% to 99%.

The behaviors observed were visual attention, program related and non-program related verbalizations, verbal and physical imitation of television content, facial expressions of mirth, and physical responses (non-imitative) to program content. Each tape was divided into several logical segments which averaged about 45 seconds each. During each segment the observer rated each observational category once for each child. The observational procedures will be described in complete detail in the final report for this study. At present the observational data have not been analyzed.

We were also interested in examining the relationship of learning outcomes to a number of demographic and individual difference variables. These also will be presented in the final report when the analysis has been completed.

The seriation criterion test was administered as a pre and posttest and again as a retention test. Retention testing was conducted approximately seven days following the posttest.

Preliminary Results

The only analysis performed to date examined differences in seriation performance among the subjects assigned to the the three viewing conditions. A one way ANOVA (groups x viewing condition) revealed no significant differences in attainment of the seriation concept among the three groups. This analysis suggests that even though the tapes were not of commercial quality, children were able to learn the complex rule-governed behaviors involved in seriation performance even when viewing was conducted in the potentially distracting company of other children. This preliminary finding lends additional weight to previous findings that children can learn complex concepts from television, at least when there is a close correspondence between the visual image and the correct solution of a problem, as is the case with seriation.

The complete analysis of data from this study will be analyzed in collaboration with Dr. Luis Laosa of the Educational Testing Service, and a complete report of the findings will be submitted to the Office of Child Development upon completion.

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